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OF THE

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VOLUME XX

TRANSACTIONS

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THE AMERICAN ASSOCIATION OF GENITO-URINARY SURGEONS

FIRST DAY, MAY 9, 1927

MULTIPLE FRACTURES OF THE PELVIS WITH RUPTURE OF THE BLADDER

HENRY G. BUGBEE

New York

The patient, a boy of twenty-one years, was admitted to the hospital on March 12, 1921, immediately following an automobile accident. He was in profound shock, the symptoms of which were progressing. There was tenderness and rigidity over the lower abdomen, but no tenderness in either lumbar region. He had a bloody urethral discharge. A catheter was passed without difficulty, only a few drops of blood being obtained. Roentgenograms showed seven distinct fractures of the pelvic bones. In view of the findings a diagnosis of rupture of the bladder was made and a suprapubic cystotomy was done at once.

Upon opening the bladder three distinct ruptures were found, one in the anterior wall extending well down into the neck of the bladder, one in the fundus of the bladder, and a third in the base. The ascending ramus of the left pelvic bone had been splintered and driven into the bladder, a spicule several centimeters in length sticking up into the lumen of the bladder. There was hemorrhage into the bladder and into the prevesical space but no definite laceration of the peritoneum was detected.

Owing to the extent of the injuries to the bladder and the critical condition of the patient, no attempt was made to suture the bladder wall, the bladder being packed with gauze and suprapubic drainage established. Under active post-operative treatment directed toward relieving his profound shock, the patient gradually improved and the question of the procedure to be adopted in treating the fractures was decided after consultation with Dr. B. H. Whitbeck, who advised conservative treatment, the pubes being immobilized with strong canvas bandages.

The suprapubic drainage was maintained until the bladder was free of infection. The urethra was found to be tortuous and an external urethrotomy was carried out one month later. With a guide introduced into the posterior urethra through the suprapubic sinus, this was easily accomplished, perineal drainage established, and the suprapubic sinus allowed to close.

The remainder of the patient's convalescence was uneventful. He left the hospital June 24, 1921, with both suprapubic and perineal

FIG. 1

wounds healed, with no urinary disturbance or apparent pelvic deformity.

He was seen one week ago, six years after the injury. He has no urinary symptoms and feels perfectly well. There is no constriction or distortion of the urethra and the bladder is normal aside from three small scars at the sites of the old injuries. The capacity is normal.

Roentgenograms show that there has been absorption of the spicules of splintered bone, the only pathology being a slight obliquity of the pelvis.

This case is reported as demonstrating the value of conservative surgery in saving the life of the patient and in restoring urinary function. In extensive lacerations of the bladder and urethra, the following seems to me a logical plan of procedure: (1) To control hemorrhage, (2) supply drainage, (3) treat the shock, a transfusion being given if the hemorrhage has been extensive, and

FIG. 2

(4) after the patient has recovered from shock and infection, to restore function by such operative measures as are then indicated, rather than attempt a primary extensive operation to repair the injury and restore function in the presence of shock, hemorrhage and infection which often means either the death of the patient or a more complete loss of function.

DISCUSSION

Dr. GEORGE W. WARREN (New York): About a year ago I had a most unusual case of bladder rupture. During a cystoscopic examination the cystoscope perforated the bladder. When advised of the accident I could hardly believe it true, although my assistant claimed that there was nearly a gallon of oxycyanide of mercury in the belly. I tried without success to get a return flow from the bladder with argyrol. Within two hours the peritoneal cavity and the bladder were opened and drained. Much to my surprise the bladder wall was so thin as to be transparent. The argyrol and air bubbles were plainly visible through the bladder wall. When opened, it proved to be about the thickness of four sheets of paper. The operative procedure was merely drainage of both peritoneal cavity and bladder. Upon recovery the bladder function, in spite of this congenital defect, was perfect.

Dr. EDWARD L. KEYES (New York): We see a good many ruptured bladders at Bellevue and have learned by the experience which almost every member of the staff has had to repeat in order to satisfy himself, that the old-fashioned injection test of putting in fluid and measuring it when it comes out is absolutely without value excepting to fool the man who does it.

The procedure which has been employed with most success, I think, where the patient is not too sick to permit it, and where diagnosis is not made by the symptoms and physical signs, is to cystoscope the patient without fear of water running into the pelvic tissue.

Dr. ROGER C. GRAVES (Boston): There is a rather interesting comment on modern surgery involved in this particular subject. I have recently been interested in it and have found that the first comprehensive review of bladder injuries was written in

1878, and that at that time there were on record some 130 or 131 cases of bladder rupture involving the peritoneum, of which all had died except one. That one had been saved through laparotomy by an American surgeon, Walther, of Pittsburgh. Twenty-five years later, another review was written on the same subject, reviewing all of the literature and adding 25 new cases. Of the 25 new cases there had been 7 cases of bladder rupture with intraperitoneal injury; 6 of them had been operated upon, and only 1 had died, a mortality of 16 per cent as compared with 99 and a fraction per cent twenty-five years before.

Dr. ANDREW J. CROWELL (Charlotte, N. C.): I would like to report a case of rupture of the bladder which came under my care following an automobile accident years ago. The patient had been drinking and was driving with a full bladder when the car was overturned. The bladder was ruptured anteriorly from the fundus to the vesicle sphincter—a clean cut split. The urine did not extravasate into the peritoneal cavity, but into the perivesical space. Practically all the cardinal symptoms were manifest and the diagnosis easily made. A suprapubic incision was made and the bladder closed. A cigarette drain was placed in the space of Retzius and a retention catheter into the bladder. There were no broken bones and the patient made an uneventful recovery.

Dr. WILLIAM W. TOWNSEND (Burlington, Vermont): I think the tolerance of the peritoneum to urinary infection is well shown in the number of times that we get into the peritoneum in doing the second stage of a two-stage prostatectomy; the peritoneum tears through and some urine gets back into the abdominal cavity. That has happened in our clinic a number of times and we never have seen any trouble arise from it. In addition to putting the drain into the peritoneal cavity, I think mention should be made of the value of the Fowler position when they are put back to bed.

Dr. GILBERT J. THOMAS (Minneapolis): The cases of rupture of the bladder that we see in Minneapolis usually occur in

individuals who are alcoholics. This condition is produced by indirect rather than by direct trauma. The last two cases that I saw occurred in individuals who were driving automobiles when intoxicated and who had not had severe accidents. Usually a collison occurred which was not with force enough to throw the patient out of the car. Because of alcoholism their bladders were full and they did not empty them promptly so that when they were thrown against the driving wheel, their bladders were ruptured. There was no external evidence that any trauma had occurred. The worst part of such an accident is that the individual is so full of alcohol that he does not realize that a serious accident has happened to him until sometimes twenty-four hours has elapsed. Then he comes in with an injury which is twenty-four hours old, which of course complicates the situation greatly, so that we have not had brilliant results following surgery. I am of the opinion that such cases should not be treated expectantly because their injuries are so old and so much damage has occurred that the majority of them die.

Dr. WILLIAM F. BRAASCH (Rochester, Minn.): The diagnosis of rupture of the bladder may be exceedingly difficult, as Dr. Keyes has stated. I remember seeing several cases where the question arose as to whether or not the bladder was ruptured. We found in one case particularly, where the history and symptoms were doubtful, that the cystogram was of value in showing extravasation of the opaque medium into the perivesical tissues. I would like to know what experience others have had with this method.

Dr. ALEXANDER RANDALL (Philadelphia): We have been using air for distending the bladder instead of a fluid, and examining under fluoroscopic control. The technique is simple. You take an ordinary atomizer bulb, filtering the air through cotton in a glass connecting tube, and watch as the air enters the bladder. In cases of rupture of the bladder you can very easily trace the air running into the cellular tissue. If the rup-

ture is intraperitoneal you see the air around the umbilicus. This has always appealed to me as being the simplest method of all and the safest.

Dr. ARTHUR H. CROSBIE (Boston): Two or three years ago in a paper, one of the cases that I mentioned in that was a man who twenty-four hours before I saw him had fallen while intoxicated and ruptured his bladder, and in him I merely opened the peritoneum and the cavity was full of urine; I drained that, with no washing out at all, then opened the bladder and drained that. No attempt was made to sew up the tear in the bladder. The man had a most uneventful convalescence, just bringing out the point that Dr. Bugbee did, namely, that you do not need to do much except drain.

LEIOMYOMA OF THE URINARY BLADDER

REPORT OF A CASE

A. R. STEVENS

Apparently it has been customary in tabulating cases of leiomyoma to include fibromata. It seems to me that this is rather a questionable point because although most fibromata come from a muscular coat, yet a certain proportion of them in all probability come from the submucosa. That is not a very important point, however, and apparently it is the custom with most writers to include all growths containing smooth muscle fibre and fibroids in one group. I just refer to this matter because it helps to clear up the discrepancies in reports, as found in the literature.

On reviewing the published reports of cases of leiomyomata of the bladder, it is confusing to note that some authors distinguish between simple fibromata and fibromyomata, while others freely include fibromata in tabulations with myomata and fibromyomata, as though all these tumors came from the muscle layers. But as some of the fibromata evidently originate in the submucous layer, it seems erroneous to include all fibromata in the lists of growths containing smooth muscle fibers. However, the point is of no great consequence, and most writers do place all these bladder tumors in one group, and call them fibroids or fibromyomata. They include also, and properly so, those growths whose histological structure suggests such names as myxomyoma or angio-myoma.

As with similar tumors of the uterus, these fibroids of the bladder have been classed as subserous, intramural, and submucous.

In April, 1922, Koll reported a case of pedunculated tumor of the bladder wall diagnosed microscopically as fibroma. His publication dealt with "benign non-papillary tumors of the

urinary bladder," and included a chart showing 38 cases collected from the literature, the total number of reliable reports bearing any of the above various labels. The group included 4 fibromata and 34 tumors containing smooth muscle fibers. There have been few reports of similar tumors since Koll's table was compiled. McNally described a subserous myoma, which weighed over a pound; Latzko, a fibroma of the dome of the bladder; Kidd and Turnbull, a case of pedunculated angio-

FIG. 1. TUMOR AND ADJACENT BLADDER WALL REMOVED AT OPERATION. ACTUAL SIZE

(Illustrating "Leiomyoma, etc." by A. R. Stevens)

myoma; and Kostjurin, a small fibromyoma with glandular inclusions located near the internal sphincter. The last case quite possibly represents a tumor of prostatic origin. Kostjurin mentions a myoma of the bladder, weighing 9200 grams reported by Kusnetzki.

While it is of course true that there have been many recognized yet unpublished cases of myomata of the bladder, nevertheless these tumors are far from common. Including the fibromata as well as all tumors containing smooth muscle, the reliable reports

to date will total few over 40 cases. Young found neither fibroma nor fibromyoma in his series of over 500 bladder tumors.

CASE REPORT

A man, fifty-nine years old, an archaeologist who had spent eighteen years in the tropics, consulted the writer on September 20, 1926. He

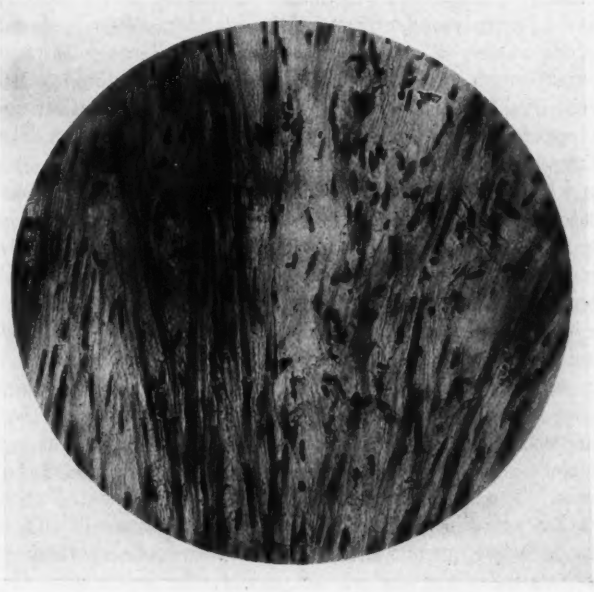

FIG. 2. HISTOLOGICAL SECTION OF TUMOR OF BLADDER
(Illustrating "Leiomyoma, etc." by A. R. Stevens)

had had malaria and dengue fever, but no other serious illness nor any operation.

In June, 1926, during the course of a cold and cough, he first noticed urinary symptoms—slight frequency of urination—and some discomfort in the back and suprapubic region. About September 1, there occurred the initial hematuria which continued off and on for a week. No further blood was evident macroscopically until the night before examination. The frequency of urination had become worse during

the summer, so that the patient was getting up two to four times each night; very recently, he had voided almost every hour at night; there was no difficulty in starting the stream. General health was good; no loss of weight, average 160 pounds.

Examination. The patient was a fairly healthy looking, very nervous man. The chest and abdomen were quite negative. The external genitalia, prostate and seminal vesicles and base of bladder all felt normal. The patient was unable to urinate, and a catheter found 2 ounces of very bloody urine in the bladder. Two cystoscopic examinations at the office were not entirely satisfactory as the patient complained much, and there was considerable bleeding, at least part of which came from the urethra; hence a third examination was made at the hospital under spinal anesthesia. The positive facts determined were the presence of trabeculation of the bladder wall, normal ureteral orifices which did *not* eject bloody urine, marked varicosities of the left ureteral ridge, a rounded mass covered with normal mucosa protruding from the anterior wall of the bladder but not associated with the prostate, and a fairly regular prostatic border accompanied, however, by a slight bas fond; there was no stone and no other tumor seen in the bladder. In the posterior urethra, there was a normal verumontanum, no papilloma, but distinct evidence of some degree of contracture of the vesical neck and of a small left lateral lobe enlargement projecting into the urethra. After emptying the bladder, the tumor of its wall could be easily felt by a finger in the rectum palpating against a hand placed on the abdomen, while the patient was under the spinal anesthesia. The appearance of the tumor was commented on at each examination as being unusual; it was rounded, covered with smooth normal appearing mucous membrane, and had a very thick pedicle. Largely because of the age of the patient, the writer was convinced that it would probably prove to be malignant, and hence was prepared with radium emanation implants at the time of operation.

For personal reasons, the patient deferred the operation two weeks, during which time there was considerable hematuria and moderate frequency of urination.

Operation. October 25, 1926. Under general anesthesia, the bladder was exposed through a midline suprapubic incision. The peritoneum was easily stripped back, and the upper two-thirds of the bladder, including the tumor region, was mobilized. The bladder was opened to the right of the midline. A nodular, hard, rounded mass, roughly 3 cm. in diameter, with pedicle nearly as thick as the body of the tumor,

was excised with about 1 cm. of normal mucosa about the mass. The bladder neck was small and unyielding, and two pieces were removed with a Young Punch. The bladder was then sutured in two layers, and a tube placed in the bladder at the upper angle of the incision. Ten gold seeds each containing 1.5 mc. of radium emanation were placed along the suture line in the bladder wall. The rest of the abdominal wall was closed in the usual manner, leaving a drain in the space of Retzius.

The convalescence was uneventful. Patient was out of bed in two weeks, but the suprapubic fistula was very slow to close. In fact, it would occasionally leak a little for several months after the patient left the hospital. At present, the frequency of urination is improved, but this symptom has not entirely disappeared as the intervals are rarely over three hours. However, there has been no hematuria since operation.

The report by Dr. Douglas Symmers, Director of the pathological laboratories at Bellevue Hospital, follows: "Microscopic examination shows the presence of a tumor made up of smooth muscle fibers, arranged in parallel bundles or as whorl-like islands, separated from one another by connective tissue which, in places, is richly infiltrated by lymphoid cells. The individual muscle fibers entering into the tumor are long and narrow, with pinkish staining cytoplasm and moderately richly chromatic, cigar-shaped nuclei. Except for the presence of lymphocytic collections in the interstitium, the histology of the tumor is identical with that of the myomata encountered in other situations, notably the uterus."

Histological diagnosis. "Simple leiomyoma. There was no histological indications of malignancy. This is the first time I have encountered this type of tumor springing from the walls of the urinary bladder."

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RHABDOMYOSARCOMA OF THE URINARY BLADDER WITH METASTASES

REPORT OF A CASE WITH BRIEF REVIEW OF CLINICAL AND PATHOLOGICAL LITERATURE

DAVID W. MacKENZIE AND WILLIAM H. CHASE

From the Department of Urology of the Royal Victoria Hospital and the Pathological Institute of McGill University, Montreal

The sarcomatous rhabdomyomata, as a neoplastic group, are so uncommon in any location that the occurrence of such a growth in the urinary bladder with metastases in the portal circulation makes the publication of this record desirable.

It seems advisable to differentiate clearly between the terms rhabdomyoma and rhabdomyosarcoma, as a review of the literature indicates that these two terms are used in a different sense by various authors. The difference in meaning seems to be based on the definition of the term sarcoma. Many authors confine the sarcomata to malignant tumors derived only from fibrous tissue. We use the term sarcomata, however, to refer to all malignant histoid tumors (11). Thus the rhabdomyoma in the strict sense is a mature pure muscle cell tumor, and the myoma sarcomatodes or rhabdomyosarcoma, as pointed out by Borst (2), is a tumor consisting of purely immature striated muscle cells. When there is a variable amount of fibrous tissue also present, the tumor is more correctly referred to as rhabdomyofibrosarcoma. Histologically therefore, the sarcomata, as we classify the group, may contain no fibrous tissue elements, but as in this case, may consist of any type of immature histoid cell.

The tumors of striated muscle are conveniently classified according to their distribution and thus fall naturally into two groups:

1. Those occurring either in the myocardium or in skeletal muscle. These are the homologous rhabdomyomata.

2. Those occurring in structures which should contain no voluntary or heart muscle. These are heterologous tumors, and are far more common than the homologous group.

The tumors occurring in the myocardium are very rare, congenital, and often multiple. They do not infiltrate or metastasize and are therefore confined to the heart. Wolbach (15) points out the remarkable frequency of a diffuse cerebral sclerosis which he found in 6 of the 12 cases that he collected. In 3 of this series the brain was not examined. In ten of the series the tumors of the heart were multiple.

Rhabdomyomata developing in skeletal muscle are nearly always subsequent to localized simple or repeated trauma. Buhl (3) published the first example of this type as early as 1865. Both his cases developed following trauma of the skeletal muscle. Muller (10) described such a tumor which developed over twenty years following the irritation of successive fractures of the femur. There are a few cases which give no history of trauma and are definitely derived from skeletal muscle.

The second or heterologous group is much the larger and concerns us more particularly in reference to this case. This group may be divided into two classes based on the probable etiological factors concerned in their development.

1. Those developing from embryonal rests in locations where striated muscle is not normally found. Cohnheim's Embryonal Hypothesis is the generally accepted explanation for the genesis of this class.

2. Those developing as part of the structure of a simple teratoma, or of an embryoma in which muscle cells of variable maturity may predominate. Himwick (8) is of the opinion that most rhabdomyomata are teratomatous, which includes the majority of heterologous and some of the homologous group.

FREQUENCY AND LOCATION

In 1903 Benenati (1) published a complete list of 65 reported cases of rhabdomyomata. More than half of these (39 cases) were located in the genito-urinary system. Only three of these were in the bladder. Wolfensberger (16) and Himwick (8) both

note that after the genito-urinary system in point of frequency comes the neck and adjoining regions. The recorded cases since Benenati's collection do not appreciably alter the proportion in different locations of the body. Four cases in the urinary bladder were described by Shattock (13) in infants under two years of age (3 in males and 1 in female), which he thinks were probably congenital. Squier (14) describes 4 cases of tumors in the prostate all of which extended into the bladder cavity.

As regards malignancy, Benenati (1) briefly mentions malignant changes and metastases in one of his collected cases. Burgess (4) describes a malignant rhabdomyoma with multiple metastases in a woman of nineteen. The primary site was not certainly localized but was most probably in the muscles of the right thigh. The urinary bladder was free. Two of the cases of the tumor in the prostate described by Squier (14) showed a gross and histological malignant picture, and one of them had extensive metastases in remote parts of the body. Monckeberg (9) describes a malignant rhabdomyoma in the urinary bladder of a woman twenty-three years old which showed no metastases, but recurred rapidly after removal.

From the foregoing brief review of the literature referable to our case, it is obvious that reported cases of rhabdomyoma occurring in the urinary bladder are rare. It is also noticeable that very few cases of a definitely malignant metastasizing type have been described, none of which have originated in the bladder. In this respect, therefore, the following case appears to be almost unique, although the metastasizing prostatic tumor described by Squier (14) is probably a similar type occurring in the opposite sex.

G. R., female, aged sixty-nine years, nationality French. Admitted to Royal Victoria Hospital, June 11, 1926. Complaining of (1) pronounced and continuous hematuria, (2) pain in the left loin radiating to the bladder and accompanied by nausea and vomiting. (3) loss of weight and strength.

She gives a history of having had during the past two years, several attacks of severe pain in the epigastrium accompanied by nausea and vomiting.

More recently, about three weeks before admission, there had been severe and persistent hematuria with the passage of many clots and this was accompanied by severe attacks of pain in the left loin radiating to the bladder.

There was only slightly increased frequency of urination and no dysuria other than that which accompanied the passage of clots. There was no previous history of hematuria.

She had gradually lost weight and strength during the two months prior to admission to hospital.

Personal history. Widow, 3 children alive and well. She did not remember any previous illness other than the exanthemata of childhood.

Family history was negative.

On admission she appeared pale and looked ill. She was in no distress. Temperature and pulse rate were normal.

General physical examination showed only slight tenderness in the left upper abdominal quadrant.

Examination of the genito-urinary system showed no costo-lumbar tenderness on the right side, the lower pole of that kidney being just palpable.

There was distinct tenderness on the left side but that kidney was not palpable.

There was no tenderness along the course of either ureter and only slight tenderness over the bladder.

The urine showed macroscopic blood, specific gravity 1.005, acid, albumen ++, sugar negative.

Microscopically: Red blood cells, ++++; white blood cells, +.

Examination of blood: white blood cells, 14,000; red blood cells, 4,300,000; hemoglobin, 70 per cent.

The red cells showed no abnormality in size, shape or staining characteristics and the white cells were in relatively normal proportion.

Cystoscopy was performed on June 12.

There was a fairly well marked cystocele.

Cystoscope was easily introduced, old fibrinous clot on bladder floor.

No tumor or foreign body seen.

Clear urine seen emerging from the right ureter.

Old blood seen coming from left.

Both ureters easily catheterized.

Skiagraphs of the kidneys were normal.

Urinalysis. Right: Macroscopically—clear straw; volume—3.5 cc.; microscopically—epithelium only. Left: Macroscopically—black (old blood) thick semi-clotted blood.

A tentative diagnosis of carcinoma of the left kidney was made.

Skiagraph of the chest was negative and evidence of metastases elsewhere was lacking, so operation was advised.

Operation. June 14, 1926. Curved left loin incision. There was marked serous infiltration about the kidney. Renal pelvis and ureter much distended with old blood clot. Ureter freed for three inches, ligated and severed with cautery. Kidney freed, pedicle clamped, cut and ligated. Wound closed with drainage.

Specimen. Kidney about normal size, dark bluish, tense, with distended pelvis. Capcule strips with slight difficulty leaving an irregular surface. On section it is brownish black with many gaping vessels. The markings of cortex and medulla are blurred. Parts of the cortex bulge somewhat and appear hemorrhagic.

Much old blood clot in pelvis and ureter.

Microscopic examination. Sections show vessels and parenchyma markedly engorged with blood. The straight tubules show an irregular swollen lining epithelium. The lumina are filled with hyaline casts and red blood cells. The interstitial fibrous tissue is markedly swollen and infiltrated with leucocytes and pus cells. This inflammatory exudate extends diffusely throughout the cortex, where glomeruli are seen in various stages of disintegration. In some areas are seen patchy calcareous degenerations. Cortical vessels show hyaline fusion and fibrous tissue thickening. Others are dilated and filled with blood.

Anatomical summary: Exudative and hemorrhagic nephritis, with necrosis.

Patient made an uninterrupted recovery and was discharged from hospital on July 3, apparently well.

Re-admission January 5, 1927. Following discharge July 3, 1926, she was free from symptoms until the middle of October, when blood re-appeared in the urine and has been practically constant since that time. The hematuria has been associated with dull pain across the back and more recently pain over the bladder as well, with severe dysuria and the passage of large clots.

She appeared acutely ill and showed evidence of loss of weight since discharge in July.

General physical examination was negative except that the liver edge was palpable. Blood pressure, systolic 120, diastolic 70.

Examination of the genito-urinary system: Scar of left loin incision. Right kidney just palpable. No tenderness in either loin or along the course of either ureter. Slight suprapubic tenderness.

Urine: Dark, acid, specific gravity 1.012, albumen ++, sugar 0. Microscopically: pus +, red blood cells +, and debris.

Cystoscopy. January 18, 1927. Instrument easily introduced. Marked ulceration with ragged slough on bladder floor, extending about left ureteral orifice and to near right ureteral orifice but not involving right orifice.

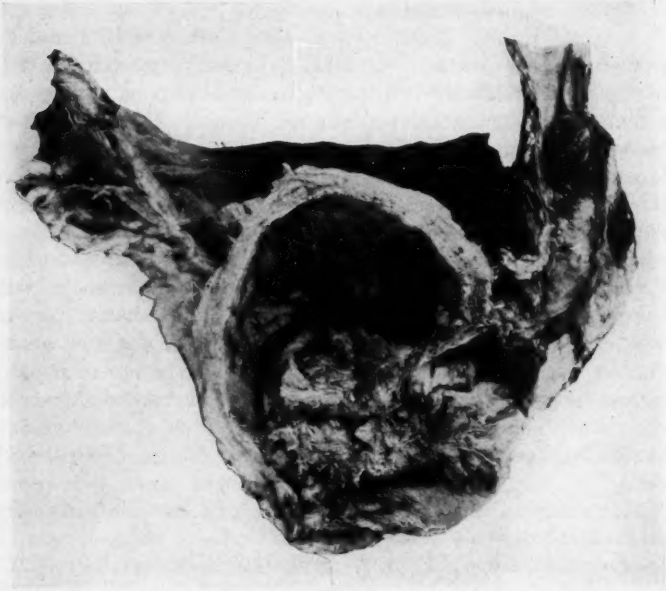

FIG. 1. PHOTOGRAPH OF THE NECROTIC TUMOR IN THE FLOOR OF THE URINARY BLADDER AND EXTENDING UP THE LEFT URETER
The bladder has been laid open and is viewed from behind

Clinical diagnosis. Sloughing papillary carcinoma of bladder involving left ureteral orifice.

Some tissue obtained, reported as hemorrhagic necrotic tissue.

The patient continued having severe distress from the passage of clots and debris, and a suprapubic cystotomy was considered for relief of distress, but the prognosis now seemed apparent, therefore symptomatic treatment was resorted to. She rapidly became weaker and died February 4, 1927.

Protocol. A 26-27. The body is that of a well developed, well nourished female. Weight 46 kgm. The gross pathological findings are confined to the tumor in the urinary bladder and its metastases in the second part of the duodenum, liver and portal lymph glands. There was a productive pleurisy on the right and an extensive broncho-pneumonia which undoubtedly was the cause of death.

The urinary bladder is markedly thickened and soft. The inner surface is covered with irregular necrotic dark grey patches with intervening dark red submucous hemorrhages.

The tumor in the bladder (fig. 1) is situated in the floor directly behind the urethra. It involves the entire trigone. The right margin extends just to the right ureteral orifice, so that it is not involved in the tumor mass. It is very soft, dark grey, fungating, necrotic, fleshy mass with a rather flat surface and slightly firmer pale grey, over-hanging margins. It is almost round, 5 cm. in diameter and protrudes quite uniformly 2 cm. above the bladder mucosa. There is very little evidence of hemorrhages on the surfaces. It is attached to the bladder by a wide extensively infiltrating base which is 2.5 cm. in diameter.

The tumor extends directly into the markedly dilated left ureter. It infiltrates the ureteral wall posteriorly at its proximal end, but elsewhere it lies as a solid, tubular, round, slightly twisted, dark grey, smooth tissue mass measuring 2.2 cm. in diameter at its proximal end and 1.8 cm. at its distal end. This solid tubular mass extends 12 cm. upwards into the dilated left ureter.

The left ureter is uniformly thick walled, and markedly dilated. It is 18 cm. long and 2 cm. in circumference at its upper end and 3.5 cm., in circumference just above the bladder. The upper end is closed for a distance of 1 cm. by dense fibrous tissue. The right ureter shows no gross microscopic lesion. The right kidney weighs 130 grams. The capsule is slightly thickened and adherent in patchy areas. The cortex shows a few small, firm, retracted areas on its surface where the cortex is adherent. The gross and microscopic picture is typical of an early arteriosclerosis with early degenerative and productive changes in the parenchyma.

On opening the gastro-intestinal tract, a tumor mass is seen on the anterior surface of the duodenum 6 cm. from the pyloric ring (fig. 2). This mass is almost circular, 2.5 cm. in diameter and is uniformly elevated 1 cm. above the mucosa of the bowel. The surface is dark reddish brown, flat and hard. It is attached to the bowel by a wide base 2 cm. in diameter, the edges are firm, slightly over-hanging and definitely

indurated. The cut surface of the tumor is pale grey, firm homogeneous and smooth. The lumen of the duodenum is obviously narrowed by the tumor, but there is no evidence of obstruction. The ampulla of Vater is situated 3 cm. beyond the growth. The bile ducts and pancreas are in no way involved in the mass. The peritoneum covering this area of serosa is smooth and glistening.

FIG. 2. PHOTOGRAPH OF THE TUMOR IN THE MUCOSA OF THE DUODENUM

A cut surface appears on the left. The pyloric ring and pyloric mucosa of the stomach are at the upper part of the picture.

A few scattered lymph glands in the portal space are moderately enlarged, pale grey, firm and shotty. On section these glands have firm, pale grey, smooth patchy areas in contrast to softer, darker grey, lymphoid areas.

The liver weighs 1065 grams. On the surface beneath the smooth glistening capsule are numerous firm, pale grey, slightly elevated areas varying from pin-head size to 1.5 cm. in diameter. The cut surface demonstrates many of these tumor masses definitely surrounding and

involving the portal spaces. The liver parenchyma is reddish brown with distinct markings.

The prominent feature of all these tumor metastases is their uniformly pale grey firmness with no evidence of hemorrhage or necrosis. This is in marked contrast to the soft necrotic bladder tumor.

Histology: Urinary bladder. Sections from the bladder wall show the typical picture of an exudative hemorrhagic and necrotic cystitis. Sections from all the superficial parts of the bladder tumor show a very extensive necrosis so that cell differentiation is entirely lost. Below this superficial necrosis is a middle zone where cell disintegration is less complete so that tumor cells can be distinguished as such, but it is impossible to study their morphological characteristics. The best reserved parts of the bladder tumor are the deep infiltrating marginal zones surrounding the left ureteral orifice. Sections from these areas show a more or less extensive infiltration of leucocytes and pus cells between a network of tumor cells. These tumor cells in the bladder are mostly rather large round or oval cells with large vesicular nuclei and a relatively small amount of pale eosinophilic cystoplasm. Nucleoli are numerous. Mitotic figures are abundant. Many of these cells are irregularly spindle-shaped with fine, short processes leading from them which seem to connect one with the other so that a loose network of undifferentiated tumor cells is formed. In some areas the cells appear to radiate from a small capillary which is engorged with red cells and leucocytes. There is no evidence of a fibrous tissue stroma.

These undifferentiated tumor cells or sarcoblasts are three to four times larger than a polymorphonuclear leucocyte. Rather sparsely scattered throughout these sarcoblasts are cells two or three times their size. The largest of these cells are characterized by multiple flattened nuclei (two to five in number) which usually are arranged at the periphery. A rather dense eosinophilic cytoplasm with a tendency to form tapering prolongations. In some cases there are clear vacuole-like spaces near the central part of the cell. Various stages in development from the undifferentiated tumor cells to these large multinucleated forms can be seen. Intermediate forms show two or three, often centrally placed, nuclei surrounded by a spindle or oval shaped-mass of fibrils and cytoplasm.

The large peripheral multinucleated cells with their central vacuole-like spaces and their tapering deeply eosinophilic cytoplasmic prolongations first suggested the true nature of the neoplasm. The cytoplasm of these cells stains very deeply with phosphotungstic acid hematoxy-

lin. Although no fibrillations or cross striations could be found in these so-called giant cells of the bladder tumor, their histological appearance is very suggestive of their myoblastic character.

Tumor in portal lymph glands, duodenum and liver. In these locations the tumor cells are much better preserved due to the relative absence of any inflammatory exudate, hence the morphological study is much easier and more reliable. The microscopic picture is similar in these

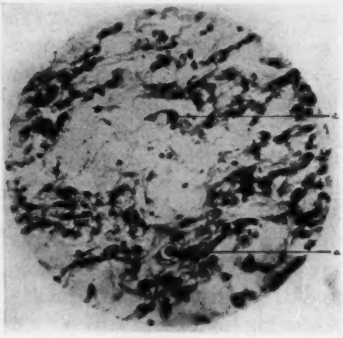

FIG. 3

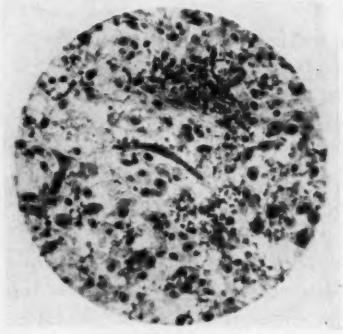

FIG. 4

FIG. 3. TUMOR METASTASIS IN PORTAL LYMPH GLANDS. × 350 DIAMETERS

This photomicrograph shows two vacuolated slightly differentiated tumor cells at *a*.

FIG. 4. TUMOR METASTASIS IN THE LIVER. × 300 DIAMETERS

A muscle cell is seen in the center of the field with an area of transverse striations just visible in the cytoplasm. At the left of the field are two muscle cells showing slight fibrillation of cytoplasm and peripheral nuclei. Note the surrounding mass of undifferentiated tumor cells.

locations so they may be described together. In the liver the tumor cells may be seen partly filling the portal veins in many areas. The relative small undifferentiated tumor cells predominate and are exactly similar to those tumor cells described in the bladder. The myoblastic giant cells, however, are more numerous and more mature. They are here characterized by peripheral nuclei and deep eosin-staining cytoplasm with prolongations some of which show definite fine fibrillations (such a cell is illustrated at the extreme left of figure 4). In longitudinal section some of the peripheral nuclei appear to be split by the clear vacuole-like area near the centre of the cell.

In addition, the sections from the duodenum and liver show a few almost mature muscle cells which have definite cross striations (figs. 4 and 5). These cells are, however, rare and only found after a search through serial sections. The striations appeared most distinctly in phosphotungstic acid hemotoxylin, Zenker fixed sections as recommended by Worthin in the examination of an inter-renal rhabdomyoma reported by Gordon and Feldman (7). It is generally recognized that plain muscle fibres may show patchy longitudinal and cross striations,

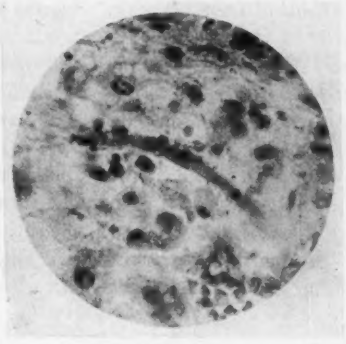

FIG. 5

FIG. 6

FIG. 5. PHOTOMICROGRAPH OF TUMOR METASTASIS IN THE LIVER. × 600 DIAMETERS

A higher magnification of the same striated muscle cell seen in the center of the field in figure 4. This demonstrates the zone of transverse striation in the muscle fibre.

FIG. 6. TUMOR METASTASIS IN THE PORTAL VEIN. × 150 DIAMETERS

Note the marked dilatation of the portal vein which is filled with undifferentiated tumor cells. The artery and bile duct are in the upper right field of the photomicrograph.

therefore to anticipate criticism these cells were carefully studied under 1/12 oil immersion lens, 15 and 20 objectives. Under this high magnification the transverse markings appeared as perfectly regular broad equidistant bands. In some of the intervening clear zones, an incomplete finely dotted transverse line could be seen. This is described as Dobie's line or membrane, which marks the limit of the sarcomere in the striated muscle fibre. Unfortunately this very high power picture does not lend itself readily to a photomicrograph.

Somewhat more numerous forms which resemble slightly less mature muscle fibres have a paler granular cytoplasm. These granules assume in some instances an indefinite faint beading. When carefully studied under oil immersion lens, however, definite striations could not be demonstrated in these cells. They are relatively mature myoblasts, some of which show definite fibrillations. These cells are distributed in a haphazard way throughout the network of undifferentiated tumor cells. The clear vacuole-like spaces are not usually seen in these more mature myoblasts, but are found in the more immature forms where they are exactly similar to those cells found in the bladder. Figure 3 demonstrates these large vacuolated cells in a portal lymph gland metastasis. The cell at the lower part of the field appears to show a concentric vacuole surrounding the nucleus. No concentric striations were found in the perinuclear cytoplasm of the vacuolated cells as has been described by Ribbert (12), Zenker (17).

Anatomical diagnosis. Rhabdomyosarcoma of the urinary bladder with direct extention into the left ureter and metastases in the duodenum portal lymph glands and liver. Exudative hemorrhagic and necrotic cystitis. Broncho-pneumonia with productive pleurisy left. Old nephrectomy left. Degenerative productive nephritis with arteriosclerosis.

SUMMARY

This tumor is primarily of interest on account of its extreme rarity in the urinary bladder and on account of its rapidly malignant characteristics.

Although it is generally recognized that the rhabdomyosarcomata are the exception to the rule, that sarcomata spread by the blood stream, this case showed definite metastases in both lymph glands and portal blood circulation. Figure 6 demonstrates a portal space in the liver in which the portal vein is dilated and filled with undifferentiated tumor cells.

The myoblastic nature of the tumor is well demonstrated in the lymph gland and portal metastases, yet it is hardly recognizable in the primary growth in the urinary bladder Ewing (6) quotes Eberth (5) and Wolfensberger (16) as having noted similar characteristics in lymph gland metastases.

Histological sections demonstrate very numerous undifferentiated sarcoblasts and scattered myoblasts in all stages of differ-

entiation. The more mature the myoblastic cells the less numerous they are in the portal metastases.

Many of the reported cases of rhabdomyosarcomata have shown no actual striation of the myoblastic cells, so that the diagnosis has been less conclusive than in this case where definite cross striations of typical muscle cells have been conclusively demonstrated.

The extensive histological search required in order to demonstrate beading and cross striations suggests that a certain number of undifferentiated malignant tumors may be mistaken for alveolar sarcomata, and hence the neoplasm may not be as rare as is indicated by the few reported cases.

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GRANULOMAS IN THE URINARY TRACT

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Localized areas of hyperplasia of the mucosa and submucosa apparently resulting from inflammation are frequently observed in the urinary tract, and for lack of a better term, may be called granulomas. These areas of hyperplastic inflammation vary from minute granular patches in the mucosa to papillomatous proliferations and, although observed most frequently in the bladder or urethra, they may be found in any part of the urinary tract. They are of clinical importance in that they may cause hematuria or favor persistent infection, and when occurring in portions of the urinary tract accessible to inspection, they may be easily confused with neoplasm. Although the specific etiologic factors and the associated conditions vary widely from case to case, yet the histologic uniformity of the lesions is striking.

GRANULOMA OF THE KIDNEY

Granulomas occurring in the kidney are rarely of much clinical importance except so far as they may be the cause of hematuria in hydronephrosis, chronic pyelonephritis and nephrolithiasis. While there are a number of factors which may cause hematuria in hydronephrosis, granulomatous areas are occasionally observed in the pelvic mucosa when the hydronephrotic sac is opened. These areas are usually dark red, bleed easily with trauma, and appear to have a low papillomatous structure. More rarely they are present as single or multiple large polypoid growths and, while usually situated at the ureteropelvic juncture, they may be scattered over the entire pelvis. Microscopic examination will reveal inflammatory hyperplasia of the mucosa

and submucosa. Hematuria occurring with chronic pyelonephritis may also result from a similar type of granuloma in the pelvis or ureter. With chronic pyelonephritis the granulomas may be more marked and the mucosal proliferation more predominant, a condition often called pyelitis granulosa. As a result of chronic irritation from stone long resident in the pelvis, granulomas may be also observed in the pelvic mucosa.

Case 1. A man, aged thirty-one, registered November 10, 1926. His chief complaint was of painless intermittent hematuria which had been occurring from four to six times a year for seven years. One year previous to examination a violent right lumbar pain was followed by profuse hematuria and relief of pain. A transfusion was required one week later. Since then hematuria had occurred once or twice each month, lasting from one to seven days, together with occasional dull pain referred to the right lumbar area.

The general physical examination was negative. The urine contained a great number of red blood cells. The blood was normal. On cystoscopic examination, complete duplication of the right kidney and ureter was found; there were two meatuses on the right. The lower segment contained a large hydronephrotic sac; the upper segment was normal.

Right nephrectomy was performed November 17. The kidney was double and there were two separate ureters. There was a large hydronephrotic sac involving the lower half of the kidney. The lower two-thirds of the kidney was destroyed. On the medial wall of the hydronephrotic sac was a raised, dark red area 1 by 5 cm. (figs. 1 and 2).

GRANULOMA OF THE URETER

Chronic infection in the ureteral mucosa as in the pelvic mucosa may produce similar lesions confined usually to one or two areas. While rarely as generalized as ureteritis cystica, granulomas have, on occasion, been observed scattered over the entire ureter. When localized and occurring near the ureterovesical juncture, as in two of our cases, the simulation of neoplasm is exceedingly close. Not infrequently with a small stone lodged in the intramural portion of the ureter, granulomas may be seen protruding from the orifice into the bladder. Neoplasm is at once sug-

gested but in such cases the possibility of a small stone must be excluded.

Case 2. A man, aged forty-seven, came to the Clinic December, 1926, complaining of hematuria. Four years previously he had suffered from a sudden attack of renal colic in the left side accompanied by painless hematuria which persisted throughout the next day. A week later another attack was followed by hematuria which persisted for

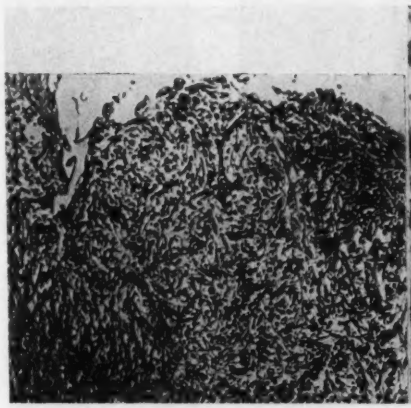

FIG. 1

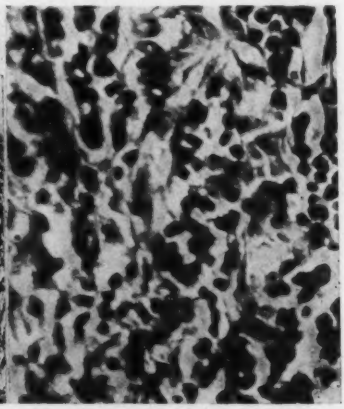

FIG. 2

FIG. 1. GRANULATION TISSUE WITH MARKED EVIDENCE OF REPAIR, CHARACTERIZED BY NUMEROUS FIBROBLASTS (GRANULOMA IN HYDRONEPHROTIC SAC). (× 60)

FIG. 2. HIGHER MAGNIFICATION OF TISSUE SHOWN IN FIGURE 1. (× 300)

two days. A similar attack occurred two years later and was followed by hematuria for two weeks. One week before he came to the Clinic the pain in the left lumbar region reappeared in association with hematuria, the blood occurring only in the first urine passed.

The general physical examination was negative, including the Wassermann test, examinations of the blood, tests of renal function and roentgenograms of the urinary tract. The urine was acid, and contained albumin graded 1, erythrocytes graded 3, and pus graded 1. Cystoscopic examination revealed a flat area 1 by 1 cm. in the bladder near

FIG. 3

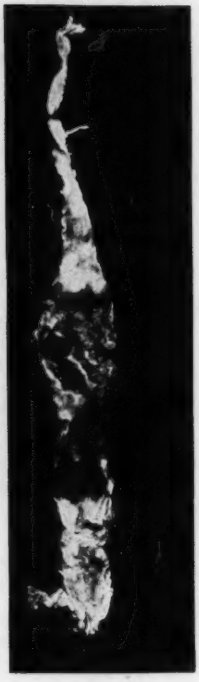

FIG. 4

FIG. 3. LEFT PYELOGRAM SHOWING SLIGHT CLUBBING OF CALICES, A NORMAL PELVIS AND IRREGULAR DILATATION, WITH PATCHY FILLING DEFECTS OF THE LOWER HALF OF THE URETER

FIG. 4. LOWER TWO-THIRDS OF URETER LAID OPEN, SHOWING LOCALIZED HEMORRHAGIC, INFLAMMATORY, EDEMATOUS CONDITION OF THE LOWER 13 CM. OF THE URETER

the left ureteral meatus; a specimen was taken for biopsy. In the left pyelogram, the calices were clubbed (graded 1) the pelvis normal and the lower half of the ureter dilated (graded 2 to 3) with patchy filling-defects (fig. 3). On subsequent cystoscopy, a catheter introduced a short way into the left ureter produced bloody urine, but clear urine appeared when the catheter was pushed to the renal pelvis. The pyelogram was as before. The report on the specimen from the gall bladder stated that it was composed of inflammatory tissue. The diagnosis was neoplasm of the lower portion of the left ureter. Left nephro-ureterectomy was performed.T here was no definite evidence of stricture in the ureter. The pathologic report was: localized hemorrhagic inflammatory edematous condition of lower 13 cm. of left ureter (fig. 4).

GRANULOMA OF THE BLADDER[1]

Granulomas occur commonly in association with cystitis. Occasionally many small areas of acute localized cystitis bearing minute granulomas are observed. The lesions are quite common in association with chronic cystitis; they may vary from one or two to several areas scattered over the entire bladder, and in these cases they are usually small, low, and without resemblance to neoplasm. Particularly is this true of non-specific cystitis. However, with a more virulent type of infection the granulomas may assume the size and appearance of epitheliomas, especially in tuberculosis, when they may be widespread and protrude from the mucosa, so that their differentiation from neoplasm becomes difficult. Thus arises a common source of confusion and patients are frequently seen following an operation for presumed neoplasm when the resected specimen showed only evidence of inflammation. This is especially unfortunate in tuberculosis, since in this disease drainage of the bladder is so often followed by a persistent suprapubic fistula.

The mucosa adjacent to the affected ureteral orifice is a frequent site of granuloma in renal tuberculosis. As this is also a common site of epithelioma, position is not of great diagnostic value. Frequently the differentiation can be made from the fact that a granuloma will flatten out or largely disappear on full

[1] Possible errors in the diagnosis of renal tuberculosis, W. F. Braasch and A. J. Scholl, Jour. Amer. Med. Assoc., March 1, 1924, lxxxii, 688-692.

distention of the bladder, a phenomenon which will not occur in the presence of epithelioma. Further differentiation is, of course, possible by the removal of specimens through the cystoscope for microscopic examination. Unfortunately, however, the removal of specimens in this manner cannot always be relied on, since it is not unusual to remove a portion of mucosa adjacent to an epithelioma and get, in consequence, a report of inflammatory tissue. The removal of further specimens will settle the diagnosis.

Granulomas occurring with incrusted cystitis are often quite luxuriant and are then easily confused with neoplasm. While it is true that areal incrustations should indicate the real underlying condition, nevertheless this may be entirely obscured. Furthermore, incrustations are not infrequently observed on the surface of a neoplasm, and are due to sloughing and deposition of urinary salts on the dead neoplastic tissue.

Subsequent to removal of a vesicle neoplasm, granulomas are frequently observed and may be difficult to differentiate from early recurrent malignant disease. While they may be seen in any portion of the bladder, they usually occur in the base and near the internal sphincter. When in the dome in the line of the cystotomy incision, they are particularly difficult to identify. Removal of vesical neoplasm by the knife is less frequently followed by the formation of a granuloma than when the cautery, diathermy or radium is used. After the latter type of treatment, granulomas may persist for several months.

Following the long-continued use of the indwelling catheter, granulomas are not uncommonly seen around the internal sphincter of the bladder. Similarly, after suprapubic drainage, they may be visible in the mucosa adjacent to the suprapubic tube. Occasionally the lesion in cystitis cystica is of unusual size and may then simulate closely bullous edema, granuloma or a cystic type of neoplasm.

Bullous edema

Protrusion of the mucosa into a mounded papillomatous form, characterized by a pale, edematous appearance, is not infrequently

observed in the bladder. It is termed bullous edema and can usually be recognized by its thick, solid appearance and its characteristic color. It is noteworthy that in this condition the cystoscopic removal of a specimen is very difficult. The lesion is usually the result of the reaction of the mucosa to some irritation in the deeper layers of the wall. Possible etiologic factors are irritation from extravesical infection, and the extension of extravesical neoplasm to the bladder. When bullous edema is the result of extravesical neoplasm, it is usually observed in the base of the bladder, since it is most often due to neoplasm of the rectum or of the female pelvic organs. On cystoscopic examination the pale, glistening elevations are pathognomonic. Bleeding does not readily occur unless the neoplasm has already reached the surface of the mucosa. When bullous edema is caused by extravesical infection, it is rarely well marked and is usually confined to the area adjacent to the infected extravesical tissue. Here again it is more common in women, as pelvic infection is so common in this sex.

Vesico-intestinal fistula is also a source of bullous edema, which is then confined to the immediate neighborhood, often effectively concealing the orifice from view.

Low-grade infection

As a result of chronic infection of low virulence, granulomas of variable size may be observed on the trigone or at the internal sphincter. When but few in number and of appreciable size, they are regarded by some as the cause of vesical symptoms. In consequence, their destruction by fulguration has been advised, and in many cases carried out. However, even though the granulomas are removed, the symptoms will usually persist until the disappearance of the underlying infection in the mucosa.

Case 3. A woman, aged thirty-seven, came to the Clinic in 1914 and in 1925. In 1911 she had consulted a physician on account of a boring pain referred to the right lumbar area, which had been present for ten years. A large hydronephrotic sac was drained and during drainage no urine was passed from the bladder. The patient first visited

the Clinic because the pain was worse. On cystoscopic examination 65 cc. of foul urine was withdrawn from the right side, without completely emptying the kidney. The patient was six months' pregnant and was allowed to go home without further examination. Parturition was normal and there was no further trouble until 1924. The patient returned in 1925 with a history of two attacks of hematuria within the preceding fifteen months. There had been an interval of five months between the attacks, with considerable bleeding just prior to admission. The cystoscopic examination showed numerous papillomas scattered over the bladder, especially in the base and trigone. Biopsy showed that the papillomas were inflammatory (fig. 5). A week later 170 cc.

FIG. 5

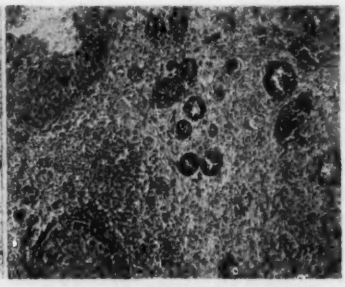

FIG. 6

FIG. 5. GRANULOMA OF BLADDER CHARACTERIZED BY NUMEROUS LEUKOCYTES BETWEEN ISLANDS OF EPITHELIUM. (× 80)

FIG. 6. GRANULOMA OF BLADDER. INFLAMMATORY TISSUE WITH NUMEROUS LEUKOCYTES IN VASCULAR CHANNELS. (× 100)

of foul urine was withdrawn through the right ureter. Two weeks subsequently a No. 9 Garceau catheter was passed.

Case 4. A woman, aged twenty-nine, came to the Clinic because of frequency of micturition, dysuria and hematuria of four months' duration. The general examination was negative. The urine was acid (pH 6.4) and contained pus (50 cells) graded 2, and erythrocytes graded 4. Cultures of the urine were negative for Proteus ammoniae, and the inoculation of guinea pigs was negative. On cystoscopic examination a granulomatous mass 2 by 1 cm. was seen in the left trigone, resembling neoplasm. A specimen was removed for biopsy and the area fulgurated. The report was: hemorrhagic inflammatory tissue with urinary salts

(fig. 6). Cystoscopic examination three weeks later showed that the granuloma persisted and 20 per cent silver nitrate was applied topically. Eight weeks later the patient returned for another cystoscopic examination. The area was then necrotic, with a small area of solid-appearing granulation remaining; 10 per cent silver nitrate was applied. Two weeks later the area was curetted and 20 per cent silver nitrate was

FIG. 7. EXTENSIVE FILLING DEFECT INVOLVING DOME AND RIGHT WALL OF BLADDER, EQUIVALENT TO ABOUT HALF THE CAPACITY OF THE BLADDER

applied to the base. On cystoscopic examination twelve days later there was no evidence of the granuloma and the bladder appeared almost normal. Subsequent reports from the patient indicate that all subjective symptoms have disappeared.

Case 5. A man, aged sixty-one, came to the Clinic in 1919, complaining of incontinence. In 1896 suprapubic operation had been performed

elsewhere, when the prostate and "a tumor" had been removed. Ever since this operation a catheter had to be used three times daily. The patient had been in fair health until 1912, when he had a brief attack of cystitis. In 1918 he was treated elsewhere for a similar attack; incontinence followed.

There was a palpable mass under the suprapubic scar. The urine contained much pus. Cystoscopic examination showed granulation tissue in the dome and posterior wall, together with diffuse cystitis of the right side of the bladder. A cystogram showed a large filling-defect in the right side of the bladder (fig. 7). A suprapubic operation was performed September 2. The bladder was thick-walled and a large mass of inflammatory tissue involving the posterior wall and dome almost filled the viscus. The tumor was opened and about 240 cc. of pus was evacuated. Part of the wall of the abscess was excised so that its cavity was made continuous with the bladder. The origin of the infection was not determined. Microscopic examination of the mass removed from the bladder wall showed inflammatory tissue only. It was evident that the tumor was a large granuloma. Postoperative convalescence was slow; a permanent catheter was introduced. Roentgenogram of the pelvis and spine was negative for metastasis. Subsequently the suprapubic sinus was dilated on two occasions and later fulgurated. Cystoscopic examination, August 31, 1921, showed a fair-sized bladder, with much scarring and granulations in the right wall and dome.

GRANULOMA OF THE URETHRA

Granulomas of the urethra associated with gonorrhea are common and need no comment here. They are widely recognized and have received adequate attention. Granulomas are frequently observed in the urethra in cases of dysuria in women. Removal of the granulomas, however, will not result in cure except in the well-known meatal caruncle. Occasionally granulomas involving the urethra are so extensive as to simulate neoplasm.

Case 6. A negress, aged thirty-six, married twice, had one child aged twenty-one. For four years she had suffered from frequency and dysuria and had passed strings of blood, pus and mucus. Cystitis was diagnosed by cystoscopy elsewhere, and irrigations of the bladder were carried out.

There was an indefinite history of syphilis treated by intravenous and intramuscular medication without particular improvement.

Physical examination was negative. Hemoglobin was 60 per cent; erythrocytes numbered 3,800,000 and leukocytes 8,300. The blood Wassermann test was negative. The urine contained pus graded 2 (22 cells). Cystoscopic examination showed chronic cystitis, the urethra was distorted and cicatricial, and a granuloma in its floor. The report

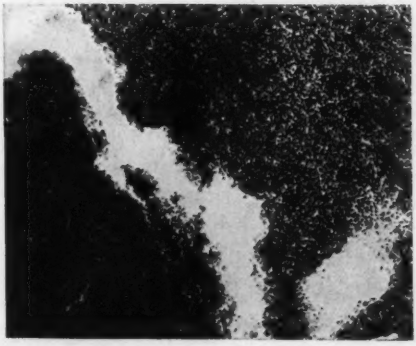

FIG. 8. URETHRAL GRANULOMA. INFLAMMATORY TISSUE WITH DENSE PLASMA-CELL INFILTRATION. (× 60)

on the specimen removed was inflammatory tissue with dense plasma-cell infiltration suggestive of syphilis (fig. 8). A short course of arpshenamin intravenously was carried out, with marked symptomatic and objective improvement. At the end of a month the local lesion had practically disappeared. The hemoglobin was 67 per cent, and erythrocytes numbered 4,220,000 and leukocytes 7000. A series of Wassermann tests on the blood carried out during the treatment gave consistently negative reactions.

DISCUSSION

Dr. HENRY G. BUGBEE: From year to year more and more instances of rare tumors of the urinary tract are being reported, indicating the careful diagnostic technic that is now employed, also the painstaking pathological study of these tumors.

Dr. GILBERT J. THOMAS (Minneapolis): The only case of granuloma of the bladder that we have a record of was diagnosed primarily as Hunner's ulcer. In this instance it was difficult to separate this lesion from a Hunner's ulcer, in spite of the fact that the latter lesion is a definite ulcer. I think that I have sent two cases to the Department of Pathology at the University that were diagnosed by the pathologist as granuloma.

Dr. FRANK S. PATCH (Montreal): I desire to report a case of unstriped muscle sarcoma of the prostate in a child of seven months, who entered the hospital with intestinal obstruction.

On operation there was found a leiomyosarcomatous tumor of the prostate obstructing the bowel. The infant lived three months after the colostomy was done. The tumor filled up the entire pelvis without metastases other than the local ones.

Dr. GEORGE G. SMITH (Boston): I would like to mention one other cause of granuloma of the bladder which I have seen following radiation of carcinoma of the uterus. There is a radium burn at the base of the bladder which in the early stages appears as an ulcer, but which, when healing, may appear as a granuloma which will give the appearance of a malignant tumor.

Dr. EDWARD L. KEYES (New York): A very interesting point has been brought to my mind by Dr. Smith. About two and a half years ago, an old friend of the family came in to see me, complaining of hemorrhage from the vagina, she being about

fifty years of age. Her cervix looked to me carcinomatous. I sent her to Dr. Bailey, who at that time, was doing the radium work at Memorial Hospital. He was using what he called a bomb, a rather heavy dose of radium against the cervix, which he applied to her and which cleared up the cervical condition. She became and remained well for two years. Last fall she came back to Bailey, telling him that she was having some hemorrhage from the urethra and he promptly sent her around to me without comment.

I cystoscoped her and saw in mid-fundus a granuloma which was very small and which I was not prepared to say was a tumor or was not. The patient was skittish; I was using a small cystoscope, could not at the moment take a specimen, and so called Bailey up on the telephone and said, "I should think Mrs. X has a carcinoma, excepting that the lesion is just over the cervix. Can it possibly be a radium burn?"

He said, "Surely, it is a radium burn. I have had three of them occurring two years after radiation. You leave her alone, cystoscope her in three months, and it will have cleared up.

That was just what happened. I have cystoscoped her twice in three months, and her bladder has spontaneously healed.

Dr. Francis R. Hagner (Washington): Following an operation for appendicitis, a patient had a small sinus remaining in the incision. On cystoscopic examination, there was a mass about 5 cm. in diameter at the top of the bladder, a granulomatous looking mass, and at once I said to the surgeon, "Was the appendix attached to the bladder?" He said it was not.

I cystoscoped this patient two or three times and it kept getting worse. Finally I said, "It must be a tumor, but you had better look at that wound." The surgeon opened the wound and there was a sponge resting on the bladder, which was the cause of the granuloma.

Dr. William F. Braasch (closing): If I correctly remember the description made by Dr. Huhner of the so-called Hunner ulcer, he stated that the area of the bladder involved is char-

acterized by a congestion of the mucosa and a prominence of the red blood vessels in the center of a pale, cicatricial area in the bladder. These areas are most frequently found in the dome and upper portions of the bladder and bleed easily on touching them. Granulation tissue is occasionally found around the edges of these ulcers; but as a rule they are characterized by the other features described.

PERIVESICAL SUPPURATION

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Perivesical suppuration or suppurative pericystitis is to be herein considered as an accumulation of pus adjacent to the urinary bladder retained by definite anatomical structures; the pus in all instances being in direct contact with the external surface of the bladder or separated from it by one or more appreciable layers of fascia. This naturally includes all sides of the bladder where such accumulation can anatomically be collected; primarily the prevesical and retrovesical separable spaces and secondarily the entire remaining external surface of the bladder excepting only a small area on its anterio-superior surface surrounding the attachment of the urachus and obliterated hypogastric vessels.

While there have been some excellent contributions in the earlier literature on this subject it has been generally neglected more recently; however, it has been discussed by Caulk (1) in Cabot's Urology and more recently by Young (2), Chute (3) in 1923 and earlier, and Aversenq (4) in 1926 have contributed most valuably to the subject.

The possible errors of neglect in diagnosis and management based on the experiences acquired in the management of 7 patients recently suffering from this condition prompts this discussion.

Case 1. Male, aged thirty-eight, was admitted to Cook County Hospital in November, 1925, with the diagnosis of acute urinary retention, having passed no urine for twenty hours. Ten days before admission he had had an upper respiratory infection of some severity which caused general symptoms such as chilly sensations and pains in his joints and muscles. Within a few days he experienced severe pain

in the rectal region which had become increasingly severe up to the time of his admission. The onset of pain was associated with urinary frequency and dysuria which likewise continued until retention occurred. He admitted having had a gonococcal infection eight years before with no permanent resulting symptoms excepting nocturia. He has been urinating two times each night since.

A resident physician had seen the man on admission at which time he had had a temperature of 99°F., pulse 88 and respiration 20 and a leucocytosis of 24,000. Examination revealed a suprapubic mass which coincided perfectly with the history of a twenty hour retention, so a soft rubber catheter was passed and 24 ounces of clear concentrated urine was obtained, which contained no abnormal elements excepting a few floating shreds. The resident was at a loss to explain why the suprapubic mass remained after the bladder was empty. One of us (H. C.) was called the next morning and found the man complaining only of a deep boring pain in the rectum, and inability to empty the bladder. A soft catheter No. 18 F. was again readily passed into the bladder and 18 ounces of clear urine obtained. This procedure did not appreciably affect the size or consistency of the suprapubic mass which extended up two-thirds the distance from the symphysis to the umbilicus, being broad on its superior border and narrowed down as it disappeared behind the symphysis, it was tense, but not hard, having the consistency of a markedly distended bladder. Rectal examination revealed the prostate to be small and firm, the vesicles could not be palpated, due to a pronounced protrusion presumably associated with the bladder, it was definitely fluctuating and gave one the impression of a full bladder. It was now observed for the first time that there was a large fluctuating left ischio-rectal mass and a similar but smaller protrusion of the right fossa. He was taken to the operating room as an emergency with the diagnosis of perivesical suppuration.

Under general anesthesia a suprapubic incision was made, as soon as the rectus fascia was incised there was a rush of foul-smelling gas immediately followed by an enormous amount of brownish pus. After the incision was enlarged it was found that the pus cavity extended from the anterior space, laterally on both sides to completely surround the base of the bladder One could readily pass an examining finger directly into each ischio-rectal fossa, through an opening in the pelvic floor not surgically made. An incision was made over each ischio-rectal fossa externally after the method of Chute (5) and copious irrigation was made of the affected spaces. Tube drainage was made through

each ischio-rectal fossa extending up along each side to the base of the bladder. Large suprapubic cigarette drains were placed laterally and anteriorly and the bladder was put at rest by cystotomy.

The patient made a slow but progressive recovery and was discharged as cured in thirty-eight days. He was seen several weeks after his discharge from the hospital at which time he was in apparent perfect health; but was found to have bilateral seminal vesiculitis. Other than this we have found no reasonable explanation for his perivesical infection excepting the possibility of metastasis from the respiratory infection from which he had just previously recovered. Cultures of the pus gave both staphylococcus and B. coli.

Case 2 A colored male, aged seventeen years, was admitted to the Cook County Hospital with a diagnosis of urethral stricture and acute urinary retention in March, 1926. Pain had been noted over the lower abdomen for five days. Two days before admission the pain had become localized immediately over the symphysis pubis and there was marked vesical irritability during this time. There was no history of urinary infection or instrumentation of any sort.

The temperature was 101.4°F., pulse 98, respiration 20 and blood pressure 110/80. It was noted that the patient was in considerable distress and was urinating every three to five minutes, which act was associated with an increase of his pain. The voided urine was normal in all respects.

Physical examination gave negative findings excepting for the presence of a suprapubic mass which closely simulated a distended bladder. More careful palpation of the mass, however, gave definite crepitation. A catheter passed easily into the bladder and but a fraction of an ounce of urine was obtained which of course made no noticeable change in the suprapubic mass. Rectal examination was negative.

As a diagnostic procedure, a trocar was passed into the midline about 1 inch above the symphysis pubis, which resulted in the collection of 800 cc. of greenish foul smelling pus, much gas was simultaneously liberated. A catheter was passed through the trocar and left in place. The pus cavity was irrigated first with water and finally with 1 per cent mercurochrome. Complete relief of symptoms was immediate and the temperature reached normal in four days and remained so. Wide incision for drainage was considered on the second day; however, the relief had been so complete and the drainage through the catheter so slight that we decided to wait. Daily irrigations were made for

four days at which time the drainage had subsided so the catheter was removed. The trocar wound immediately closed and he had no further trouble, being discharged from the hospital in eight days after admission. He was seen in four weeks and was well.

Cultures gave a growth of B. coli only.

No etiological factor could be discovered for this infection.

Case 3. A colored male, aged sixty-one years, was admitted to the hospital in August, 1926, with a diagnosis of prostatic hypertrophy. He had been in good health up to a year before when he first noticed frequency of urination, especially marked at night. This symptom was associated with a gradually increasing dysuria and finally with some dribbling of urine. Burning, during and at the end of urination began about six months before and had gradually become more marked up to the time of admission. Complete retention occurred six days before admission, at which time he became bedfast and was catheterized by his doctor once daily.

Examination revealed an emaciated old man with a temperature of 99.2°F., pulse 92, respiration 20 and blood pressure 138/70 and general findings only of a chronic myocarditis. A tender tumor mass was felt above the symphysis pubis. Rectally the prostate was greatly enlarged, smooth, moderately firm and symmetrical. A catheter was passed and 8 ounces of very purulent material was obtained. This did not appreciably change the characteristics of the suprapubic tumor. The bladder was irrigated. On the second day a catheter could not be passed and the resident physician made an emergency suprapubic trocar puncture and obtained nothing but thick pus. Suprapubic catheter irrigation was done with more difficulty than success. The next day under gas anesthesia a suprapubic incision was made and found the suprapubic catheter lying on top of the bladder in a large abscess cavity which extended laterally on both sides to completely surround the bladder. The suppurating cavities were freed of the purulent material by irrigation. The bladder was opened, presenting a thick wall the external surface of which was everywhere covered with a closely adherent necrotic debris. The mucosa was granular, swollen and covered at isolated places by muco-purulent material. A large trilobular intravesical prostate was felt. Tube drainage was made to the bottom of the pus cavities on both sides of the bladder, opening suprapubically with the bladder tube.

Daily irrigation was made of the pus cavities and bladder. The

pus drainage was profuse and the urine drainage scant, in spite of large amounts of glucose solution intravenously and salt solution under the skin.

Death occurred four days after cystotomy apparently from sepsis.

Necropsy findings were the following: Marked adenomatous hyperplasia of the prostate gland; suppurative cystitis; bilateral suppurative and hemorrhagic pyelonephritis, with multiple abscesses of the kidneys; sub-acute left peri-nephritic abscess continuous with left suppurative periureteritis and huge pericystic abscess; left psoas myositis; recent gangrenous cystotomy wound; focal fibrous peritonitis with adhesions of the small bowel to the bladder apex; focal broncho-pneumonia of the left lower lobe; chronic splenitis; generalized arteriosclerosis and scars of the myocardium; chronic fibrous seminal vesiculitis; cloudy swelling of the liver and myocardium; generalized emaciation.

The pathologist ventured the opinion that the suppuration was primarily left peri-renal, descending along the course of the ureter to eventually surround the bladder. Clinically it would be more reasonable to assume that the perivesical suppuration was primary with ascending involvement of left ureter and peri-nephritic fat.

We have considered this an instance of peri-cystitis secondary to a marked chronic suppurative cystitis with retention.

While it is apparent that this man was hopelessly septic when first seen by us, we feel now that dependent perineal drainage was indicated, as uphill suprapubic drainage was most inadequate. Had proper drainage been made twenty-four hours before instead of a suprapubic trocar puncture the result possibly might have been different. The peri-renal infection was not suspected clinically.

Case 4. A male, thirty-two years old, was admitted to the Cook County Hospital in April, 1926, with a diagnosis of peri-urethral abscess and right epididymitis. There was a history of gonorrhea almost constantly for the last eight years. Early in his venereal experience he developed a perineal abscess which opened spontaneously leaving many perineal urinary fistulae.

Examination presents a chronic right epididymitis, indurated and thickened perineum and lower third of scrotum. Many perineal fistulae were present which were discharging pus and urine. Calibration of the urethra demonstrated the presence of a tortuous stricture of the bulbous urethra.

Under caudal anesthesia an external urethrotomy was made and a

soft catheter was sutured into the bladder. Due to the precarious condition of the patient no attempt was made to excise the urinary fistulae.

Post-operatively he was given fluids both intravenously and under the skin.

On the first post-operative day it was necessary to wash blood clots from the bladder. Drainage through the catheter, though present, had not been good. It was observed that the patient was straining constantly and complained of low abdominal pain. There was extreme tenderness over the bladder region but no palpable mass. The temperature remained around 100°F. during the next four post-operative days while the abdominal tenderness became more severe and the perineum became more swollen, still no palpable mass was present suprapubically. From our previous experiences we felt that we were confronted with a perivesical infection. Rectal examination was negative. A suprapubic incision was made and about 500 cc. of thick colon like pus was freed from the anterior separable space. The cavity did not extend laterally. Tube drainage was established suprapubically. The bladder was not drained.

The painful symptoms subsided at once. Two days later the patient developed an erysipelas of the face from which he died in two days.

No necropsy was performed. Several similar instances of perineal abscesses and fistulae have been managed successfully since this experience, by making a preliminary cystotomy and cleaning up the superficial infection of the perineum before making the necessary urethrotomy. Had this been done with this patient we feel that the outcome might have been different.

This perivesical infection has been classified as one produced by sepsis carried to the region of the membranous urethra by surgical trauma, and thence to the perivesical space by lymphatics.

The pus gave a pure culture of B. coli.

Case 5. A white male, forty years old, was admitted to the Cook County Hospital with a diagnosis of cystitis, the chief complaint being pain over the bladder region anteriorly. He had had a gonorrheal infection twenty-one years before followed by an urethral stricture which was cut by external urethrotomy six weeks before, at another hospital. He was doing well and had closed perineally after the passage of sounds on three or four occasions. Finally a No. 32 F. sound was passed with difficulty and immediately he began to have suprapubic pain associated with vesical irritability.

He was transferred to Cook County Hospital in this condition with a temperature of 99°F., pulse 92 with frequent and painful urination and severe suprapubic pain.

Physical examination was generally negative excepting for tenderness suprapubically, the urethrotomy incision was healed. Rectal examination was negative. Osteomyelitis of the pubes was suspected, but x-ray examination showed no bone changes. He slowly developed pain when moving his legs; due to the severity of this symptom he finally was unable to walk.

Six days after admission or eleven days after the passage of a large sound, with considerable trauma, there was a very definite suprapubic mass after the bladder was known to be empty. The skin over the mass was rapidly acquiring an inflamed and swollen appearance. He was taken to the operating room with a diagnosis of perivesical infection.

Suprapubic incision revealed a thick walled abscess cavity over the anterior aspect of the bladder. Several ounces of white pus was evacuated by swabbing. There was no odor as in the previous patients. The cavity did not extend laterally, but was apparently confined within the boundaries of the anterior separable space.

Tube drainage was established to the bottom of the cavity and the fascia and skin closed loosely. The bladder was not opened.

The suprapubic pain was at once relieved together with the symptoms of vesical irritability. Motion of his legs no longer caused distress.

The drainage was slowly removed and was entirely out on the eight day. His wound was completely closed on the eleventh day and he was discharged as well.

He remained well for at least four weeks following his discharge from the hospital.

This infection has been classified as one produced by trauma by sounding in the presence of urethral sepsis, followed by lymphatic infection of the anterior separable space.

Case 6. A white male, sixty-eight years old, was admitted to St. Luke's Hospital November 8, 1926, with acute urinary retention due to hypertrophy of the prostate.

After decompression of his bladder it was deemed advisable to do a preliminary drainage. There was marked cystitis. After three weeks of drainage and daily bladder irrigation a prostatectomy was done. At the time there seemed to be no necessity of draining the prevesical space which appeared to be well walled off.

The patient recovered very slowly requiring much fluid under the skin and glucose by rectum. He could retain very little fluid or nourishment by mouth. He ran an irregular temperature which reached 100° F. daily. He was very weak and getting weaker daily. He was considered an instance of post-operative pyelonephritis and was managed accordingly for two weeks. He complained of pain in the right lower abdominal quadrant. There was nothing about the incision or suprapubic region out of the ordinary. A rectal examination, however, revealed a marked fluctuating protrusion. The suprapubic incision was draining in an apparently normal manner.

The diagnosis was evident, so the incision was reopened and the bladder edges separated from the abdominal wall to which it was quite firmly adherent. There was a gush of very foul-smelling pus which seemed to be endless. When exploration could be made it was found that the bladder had been literally floating in a pool of pus. The region of the attachment of the urachus only remained adherent. The cavity was thoroughly irrigated and tube drainage established down to the base of the bladder. The pain and the temperature subsided at once. Daily irrigation of the cavity was made for six days and the drainage tubes were slowly removed, being out on the tenth day.

The change in the patient's general condition was most striking. From a man who had been forced to eat, we had a man who had a ravenous appetite. He very rapidly gained in weight and strength and the incision was completely closed in three weeks. He was discharged January 30, 1927, about three months from the time of his admission. He has been seen repeatedly since his discharge from the hospital and is in fair health, but still has a marked pyuria, but has a normal bladder capacity and tolerance.

There is no reasonable doubt but what this marked perivesical suppuration resulted from inadequate perivesical drainage following prostatectomy; however direct extension from a markedly infected bladder must be considered a possible cause.

Case 7. White male, fifty-seven years old, was admitted to Cook County Hospital in January, 1927, with the examining room diagnosis of hypertrophy of the prostate. He has had difficulty of urination for eight years; many times during this period he would experience spells of straining when only a few drops of urine would pass. This condition has always been worse during the winter months. During the past winter it has been even more difficult for him to urinate but

he has never had complete retention. On admission he also complained of weight and a dragging sensation deep in the pelvis and around the rectal region. He urinated twelve or more times during the day and six to eight times at night, always with burning and much distress. Blood cells were found microscopically in an otherwise normal urine. There had been a gonococcal infection thirty years before with no known complications or sequellae.

On examination the heart was enlarged but otherwise normal, there were umbilical and bilateral inguinal herniae.

A soft rubber catheter was passed into the bladder and 14 ounces of residual urine was obtained; a rectal examination then revealed a prostate only slightly larger than normal and of normal firm consistency. The temperature remained below 100°F. On his third hospital day it was impossible to pass a catheter to remove the residual urine. The deep pelvic pain was increasing in severity so the house physician made a suprapubic cystotomy. The interior of the bladder was not explored. This gave some relief but did not influence the pain of which he most bitterly complained. Our attention was not called to him until one week after his cystotomy, when a rectal examination disclosed a pronounced fluctuating mass in the midline not connected with either prostatic lobe. There was no mass or tenderness suprapubically.

A diagnosis of retrovesical abscess was made and he was immediately ordered up for drainage.

After increasing the cystotomy opening the base and posterior walls of the bladder were felt to be forced anteriorly so as to actually come in contact with the anterior bladder wall. An examining finger carried down over the top of the intravesical mass found the internal urethral orifice about 3 inches distally. The orifice was very difficult to locate but felt normal as did also the bladder mucosa, there being no findings of hyperplastic prostatic lobes or contracture of the vesical neck. During this examination by the second interne, the field suddenly became obscured by a thick white pus, which subsequently was found to be oozing from a rent in the floor of the bladder near the proximal aspect of its fundus. A finger placed in this opening could be swept for its full length in all directions, extending downward behind the prostate laterally over the seminal vesicles and upward in close contact with the posterior wall of the bladder; further exposure found the prevesical space free from infection, likewise the lateral perivesical tissues. The cavity was opened laterally on both sides and tube drainage placed, after which thorough irrigation of the cavity was made. The bladder

was closed with tube drainage. The anterior space was likewise protected with drainage. Drainage was moderate for three to four days and the tubes were removed completely in one week. The pain subsided at once and he made a rapid closure of his bladder opening. He was discharged from the hospital feeling well. He has been seen frequently since and remains free from symptoms, but still has quite a considerable pyuria. Rectal examination is now entirely normal.

Cystoscopic examination eight weeks after drainage of the abscess presents an area of hyperemia and edema about 1 inch in diameter in the bladder fundus; otherwise it presents only the findings of chronic cystitis. There seems to be no drainage from the retrovesical abscess into the bladder; at least none can be observed cystoscopically, while a finger in the rectum manipulates the base of the bladder.

This patient still has frequency of urination, which is decreasing gradually with the decrease of his cystitis.

Cultures of the pus gave a pure culture of staphylococcus.

No explainable etiological factor was found in the history of findings of this patient for his perivesical infection.

COMMENT

In further consideration of the histories, findings and end results of the afore-mentioned patients it is readily observed that the perivesical tissues are arranged to form certain definite potential spaces all of which may be united into one, under the influence of infection and its resulting necrosis and pressure from suppuration.

Anteriorly the fasciae are so arranged that three definite spaces are formed (fig. 1). It is to be noted that the lower part of the rectus muscles has no definite sheath posteriorly, this structure ending just below the umbilicus in a thickened fold called the semicircular fold of Douglas. Extending downward from this cresentic edge are two thin layers of fascia, the anterior one covering the lower posterior surface of the recti muscles and attaches itself to the symphysis, while the posterior of the two layers extends down over the anterior surface of the bladder to join to the true pelvic fascia. There is thereby formed a small retromuscular space, which does not concern us in this discussion and a prevesical space or space of Retzius, which is bounded

anteriorly by the symphysis pubis and the anterior layer of fascia and behind by the posterior layer of the same fascia. This space is limited above by the fusion of the two fascial layers at their origin from the semicircular fold and laterally it is limited by the fusion of these two layers of fascia with the aponeurosis of the transversalis and oblique muscles. Below it is limited by the periprostatic aponeurosis of the true pelvic fascia. Aversenq (4) has described a third space which he choses to call the perivesical space, bounded anteriorly by the prevesicopelvic sheath (posterior layer of fascia described above) which joins the periprostatic sheath behind the symphysis pubis, superiorly by the peritoneum and posteriorly by the bladder musculature.

Posteriorly the fasciae are similarly arranged to form definite separable spaces. It is of importance to understand that the upper part of the parietal pelvic fascia is continuous with the fascia of the psoas muscle. The aponeurosis of Denonvilliers surrounds the prostate as a firm fibrous sheath and is continuous with the rectovesical fascia. The upper portion blends with the fascia covering the bladder, anteriorly it forms the puboprostatic ligaments; below it is continuous with the deep layer of the triangular ligament; posteriorly it is continuous with the rectovesical fascia and covers and binds the seminal vesicles to the bladder (6) (fig. 1). Thus there is developed a potential space between the sheath of the prostate and its continuation upward over the seminal vesicles and the rectal layer of the rectovesical fascia (anterior layer of Denonvilliers fascia). Aversenq (4) has described a second space, the periprostatic space situated between the prostatic capsule and the above described, prostatic sheath.

Concerning the etiology of these 7 cases there are certain definite recognizable factors in 5 of them, while in 2 (cases 2 and 7) no cause could be found. We have considered seminal vesiculitis as the most likely factor in case 1, while case 3 no doubt acquired his perivesical infection from a suppurative cystitis; while the infections of cases 4 and 5 were produced by surgical trauma of the bulbous and membranous urethrae in the presence of sepsis; inadequate prevesical drainage following prostatectomy caused this complication in our sixth case.

There are several classifications of etiological factors of this condition, but the grouping into those of urinary and non-urinary origin answers all practical purposes and seems the most logical.

Regardless of the work of Hallé and Motz (7) which tends to show that acute bladder infections never cause infection of the musculature or pericystic tissues, it is quite generally considered that intravesical infections are directly responsible for many instances of perivesical infection; certainly this would appear to be the case in our third patient. Other intravesical conditions, associated with infection, likewise are known to be causative factors; such as calculus, foreign body, diverticuli, ulcers, tumors or tuberculosis. The infection is sometimes an extension from the appendix, sigmoid, rectum, uterus and adnexae, prostate, seminal vesicles, urethra and pubic bones. Operative or instrumental trauma to the region of the membranous urethra is a common cause of prevesical infections. This may come about by false passage and direct contamination of the space or indirectly, supposedly by lymphatics. The lymphatics of this region have not been sufficiently clearly worked out to positively solve this point, but there are many clinical demonstrations which indicate this probability as seen in our patients four and five.

Englisch (8) has reported a series of so-called idiopathic cases of perivesical infection, which he explained only on the basis of blood stream infection from some distant focus. Two of our patients would be put in this class.

Generally speaking these abscesses may break beyond their anatomical boundaries to appear in somewhat distant locations. Such was the post-mortem finding in our third case where the pus cavity was traced upward on the left side to form a subacute perinephritic abscess. The direct continuation of the pelvic fascia with that covering the psoas muscle would suggest a more frequent occurrence of this extension. Our first patient presented a downward extension of pus to present in both ischiorectal fossae; this of course is only possible by the solution of continuity of the superior layer of pelvic fascia, the levator ani muscle and the inferior layer of pelvic fascia. This was clearly

demonstrated in this instance and serves to emphasize the logic of Chute's (5) suggestion of perineal drainage. Other complications such as rupture into the bladder, rectum and peritoneal cavity are described, but fortunately the number seems not great. Spontaneous evacuation through the skin suprapubically will occur very late in the disease, but with our present knowledge of the condition it should never occur.

The outstanding feature of our cases has been the presence of pain over the lower abdominal region or deep in the pelvis; this has varied from slight discomfort to a most severe and unbearable pain which requires morphine repeatedly to control. While this pain may vary somewhat in its severity at different times in the same patient, it is nevertheless constant. Movements of the hip joints have increased the pain in two of our cases which resulted in their lying on their back with knees and hips slightly flexed. This point may be of diagnostic importance in obscure cases. Three of our patients have complained bitterly of pain about the anus supposedly caused by hemorrhoids; however, no hemorrhoids were present and the pain left with the drainage of the pus.

Vesical irritability has been a pronounced symptom in 3 cases characterized by frequency of urination and tenesmus, while 3 others were suffering from complete urinary retention, only 1 of these having obstruction to cause it and that an adenoma of the prostate.

Gastrointestinal symptoms were a marked feature in but 1 case and this a persistent vomiting.

In general it may be said that the symptoms depend somewhat on the cause of the suppuration, all having an intermittent fever which may be slight or marked, sometimes associated with chills and other signs of severe sepsis.

The diagnosis is not always easy during the early stages before fluctuation can be felt suprapubically or rectally. The chief diagnostic sign, of course, is the presence of a fluctuating mass rectally above the prostate, or suprapubically when the bladder is empty. This important sign was present in 6 of our 7 cases, 4 of whom presented easily recognized anterior masses and 2

were diagnosed by rectal palpation. One presented both types of fluctuation and a second undoubtedly would have done likewise were it not for the presence of an enormous prostate to obstruct the examining finger.

In obscure cases with indefinite pelvic pain, associated or not with bladder symptoms and having general signs of infection, it would seem advisable to palpate carefully all accessible perivesical regions for tenderness, inflammatory induration or even early suppuration. Information in regard to the condition of the urethra, as to its patency, whether recently instrumented or not may be most pertinent. Cystoscopic examination may reveal an intravesical protrusion which can not be completely effaced by complete bladder distention. This was present in only one of our cases observed intravesically, our seventh patient, who had the localized retrovesical abscess which protruded anteriorly to close off the internal urinary meatus and produce retention. This picture was correctly described by the cystoscopist who thought it was an enormous intravesical prostate.

Urinary findings are often misleading as they are frequently negative; this was the condition in both of our idiopathic cases and also our case produced by seminal vesiculitis; all others contained varying amounts of pus and pyogenic organisms.

The most confusing condition in our experience, before the definite findings of suppuration appeared, was pyelonephritis. Three of our patients were so diagnosed first. A distended bladder can easily be ruled out as should also a pelvic peritonitis. Acute prostatitis may confuse, but careful local investigation should soon suffice. New growths of the pubes or in the subprostatic region, however, usually carry no findings of sepsis and rarely develop so rapidly as to be misleading for long.

The prognosis in these infections naturally will depend very much upon the causative factor in secondary infections; those of urinary origin, especially those of bladder origin have a worse prognosis than the blood borne infections, due probably to an associated renal infection and the poor general condition resulting from the long standing urinary sepsis.

We had two deaths and five recoveries. For the type of

infection represented in this series our mortality is too high. We feel that both of our fatal cases might have been saved as they were not adequately drained. One of our deaths was from infection directly from suppurative cystitis resulting in perirenal suppuration which was not recognized clinically; he was allowed to go at least 48 hours longer than necessary before even insufficient drainage was established. Had his perirenal infection been drained and counter perineal drainage of his pericystic abscess been done early our mortality statistics might have been better.

Our second death was in an infection resulting from urethrotomy in the presence of marked perineal sepsis. Experience acquired in the management of this patient will no doubt reduce our future morbidity and even mortality. We now drain all such patients by suprapubic cystotomy until the perineum has been somewhat reduced of its septic condition before urethrotomy is performed.

As in any collection of pus the essential in treatment is adequate drainage. This can be accomplished in all instances, regardless of the localization of the pus by suprapubic incision and counter perineal drainage in certain retrovesical accumulations. Young (2) has clearly described a method of perineal drainage alone for retrovesical abscess which gives excellent dependent drainage and should be the method of choice where the diagnosis of extent is clearly established. Should there be any evidence whatsoever of anterior space involvement together with the retrovesical space infection the anterior incision should be made and aided by a stab perineal drainage on one or both sides if thought necessary by the operator.

In the more extensive pus invasions where suprapubic incision is made we believe an accompanying cystotomy should be made. This puts the bladder at rest, allows for better perivesical drainage and aids in the care of intravesical or even intrarenal infection. Perhaps cystotomy should be considered in all instances of perivesical suppuration thought to be an extension of intravesical infection.

We have found that the immediate post-operative manage-

ment is most important. All of these patients require large amounts of fluids, which we have supplied by mouth, under the skin and even intravenously, together with a slow drip into the rectum of glucose and soda bicarbonate solution. At least two of our patients were saved by strict attention to this feature of the management.

SUMMARY

Perivesical suppuration, while not a common occurrence, is one of the end results of perivesical inflammation, regardless of the etiology of this inflammation. Early in its course it produces no signs or symptoms by which it can be positively recognized; however it should be suspected and careful daily examination made for its presence in all patients complaining of constant indefinite pelvic pain either anteriorly or rectally. Special attention should be directed toward this possibility should pain be associated with vesical symptoms, with or without the findings of pathologic urine.

The mortality from the suppuration itself should not be high if recognized and properly drained. The primary cause of the secondary suppuration however may be of such a nature as to preclude the possibility of a cure.

The morbidity is usually great due to the general effect of long continued sepsis. Attention to the general condition of the patient, following the drainage of pus can materially shorten the morbidity and perhaps tend to reduce the mortality. We would again emphasize, in this connection, the pushing of fluids by all the available methods, together with the continued use of glucose and bicarbonate solutions per rectum.

Attention is directed to the dangers of improper, especially traumatic urethral instrumentation in the male.

It is suggested that preliminary cystotomy be made in all instances where perineal section is contemplated in a patient with chronic perineal sepsis, such as is seen in multiple perineal fistulae. This makes for a safer field for perineal section later.

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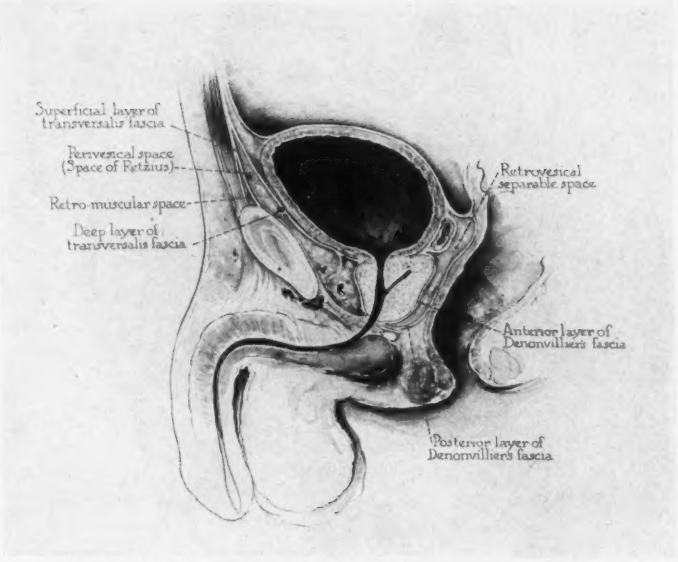
Superficial layer of transversalis fascia
Perivesical space (Space of Retzius)
Retro-muscular space
Deep layer of transversalis fascia
Retrovesical separable space
Anterior layer of Denonvilliers fascia
Posterior layer of Denonvilliers fascia

FIG. 1. DRAWING TO SHOW THE STRUCTURES CONCERNED IN THE FORMATION OF THE POTENTIAL SEPARABLE SPACES ABOUT THE BLADDER

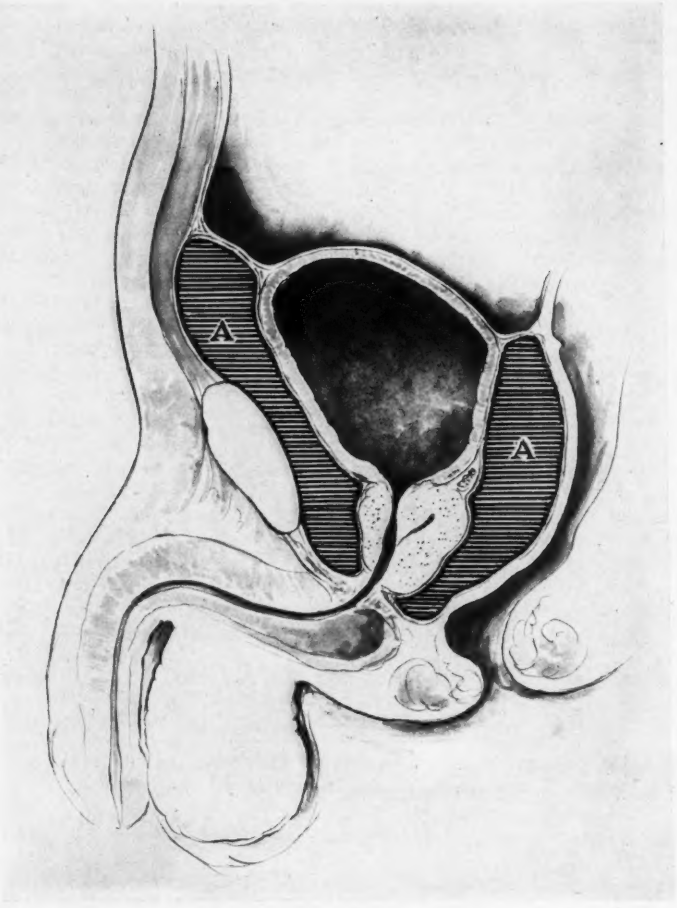

FIG. 2. DRAWING REPRESENTING LOCATION OF PUS (*A*) IN PATIENTS 1, 3 AND 6

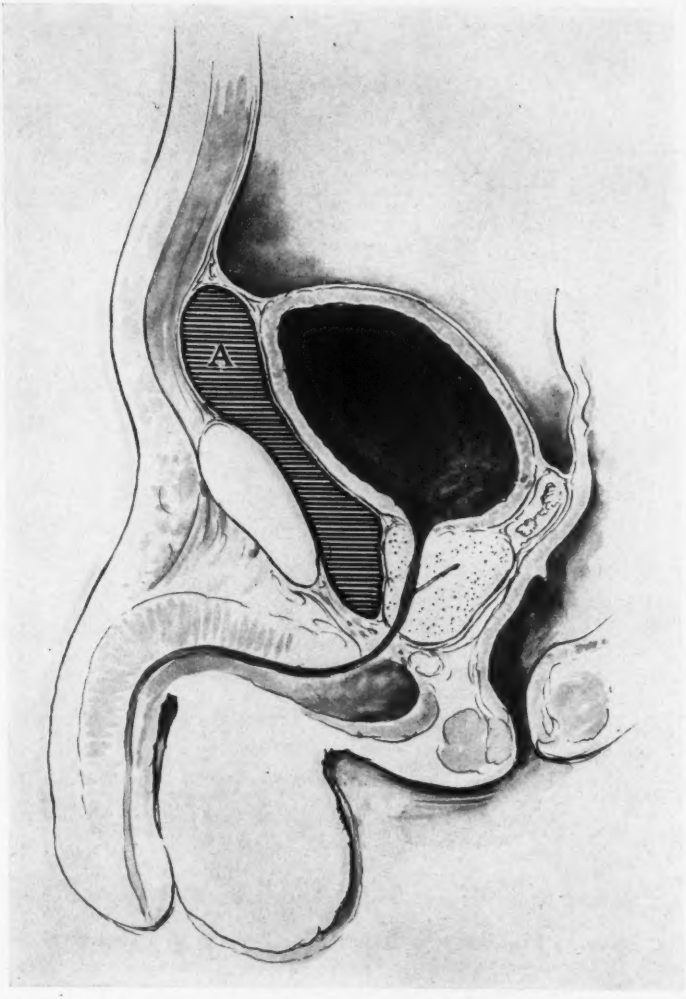

FIG. 3. DRAWING REPRESENTING LOCATION OF PUS (*A*) IN PATIENT 2

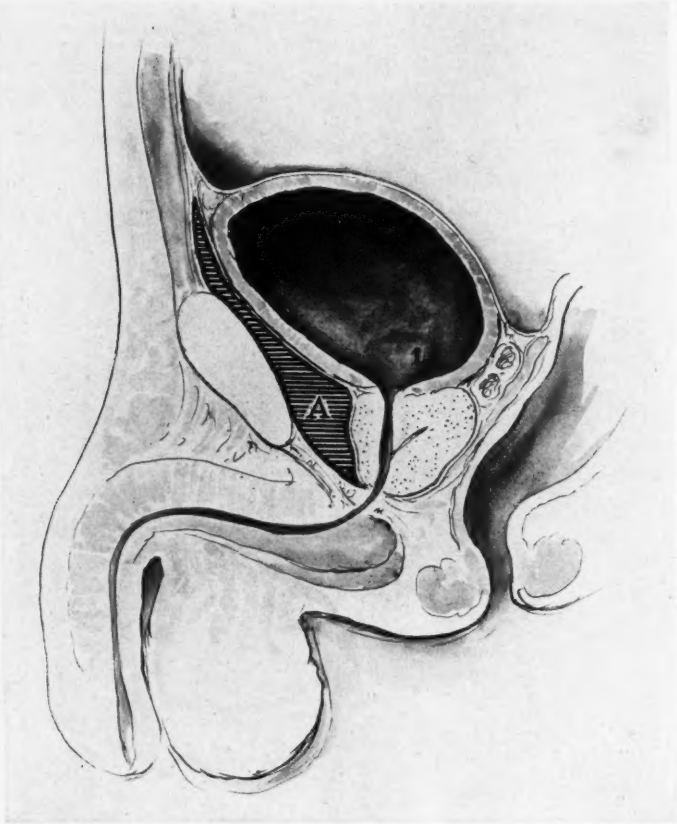

FIG. 4. DRAWING REPRESENTING LOCATION OF PUS (*A*) IN PATIENTS 4 AND 5

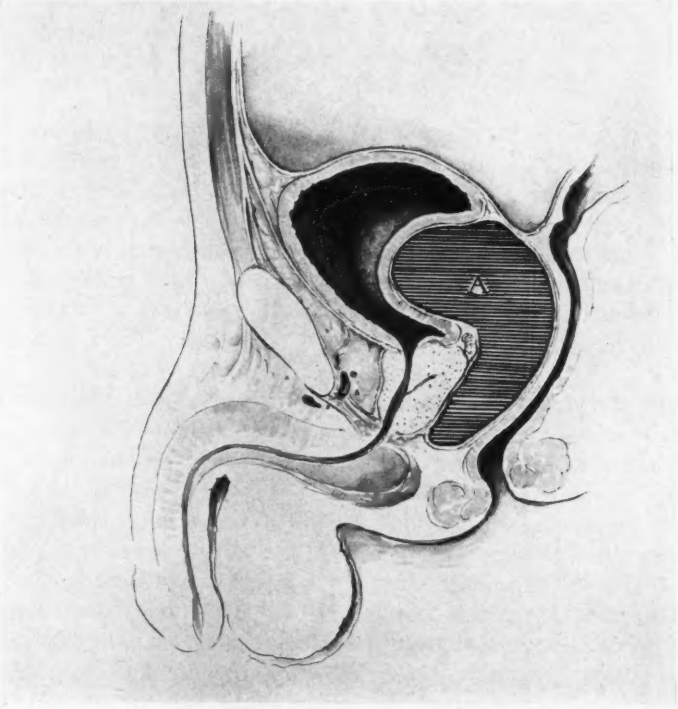

FIG. 5. DRAWING REPRESENTING LOCATION OF PUS (*A*) IN PATIENT 7

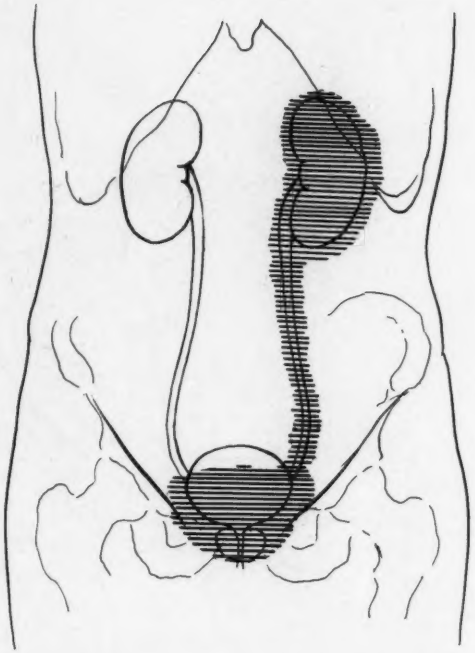

FIG. 6. DRAWING REPRESENTING EXTENSION OF PUS FROM PERIVESICAL REGION UP ALONG THE LEFT URETER AND AROUND THE LEFT KIDNEY IN PATIENT 3

SUPPURATIVE PERICYSTITIS

REPORT OF TWO CASES OF UNKNOWN ETIOLOGY

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Suppurative pericystitis has been, in my experience, observed far too infrequently to insure prompt recognition. It constitutes a serious menace to life. Its early recognition is imperative for a high percentage of recoveries. In those instances in which the condition has been found, the medical consultant has not included it in his differential diagnosis or always known of its existence as an entity. The diagnosis of pus in the deepest and most inaccessible portions of the pelvis may offer difficulties in diagnosis until tumefaction develops.

The pericystic tissues are well protected by fascia layers from pus invasion. Once a suppurative process gains admission to the loose tissues which surround the elastic and constantly changed in volume organ, the bladder, wide spaces for spread of infection are available. Absorption from this large area readily takes place and produces profound degrees of acute febrile reaction and chronic septic changes. Pus about the bladder is free to extend about the whole of the bladder except its peritoneal attachment and its trigonal surface. In some instances, however, it may localize to produce a less extensive process on one side or the other of the bladder.

The terms "pericystitis" and "paracystitis" have been confused in description. They are not greatly dissimilar conditions as regards symptomatology and treatment. They are certainly not capable of clinical differentiation, but only recognizable from operative or postmortem findings.

Two types of suppurative change are found: one, the phlegmonous infiltrating type, and the other a suppurative condition with abscess formation. Bacteria of many varieties have been found

in the septic areas. Staphylococcus aureus and albus, the colon bacillus and streptococcus are found in that order of frequency. Many infections are mixed, with a large variety of bacteria present.

Infection reaches this space most often by trauma. This includes injury from accident, urethral injuries from instrumentation and operation on genital, urinary or pelvic organs. It may also come through direct dissemination through the lymphatics from appendiceal abscesses, intestinal suppuration such as diverticulitis, or tubal abscesses with or without rupture of the peritoneum. A third mode of entry seems to be blood stream infection reaching the lymph nodules of this region as a part of a generalized infection. In this type of case the organism is usually the staphylococcus.

Pasteau finds the majority of the cases in women to be due to pericystitis from long-standing urinary tract infections. Second in frequency to urinary infections, the appendiceal and tubal abscesses are named. The condition is, however, much more common in men than in women, and the commonest cause in men by far, is trauma to the urethra and surgical operations on the prostate and bladder. Aversenq mentions perforations into the paravesical tissues with abscess formation in tumor growths of the bladder, also tuberculosis. Hogge mentions blood clot resulting from injury collecting in the suprapubic space, later becoming septic.

Complications to pericystitis are the common ones associated with closed septic processes, namely phlebitis, thrombosis of pelvic vessels, metastatic abscesses, septicemia and the systemic changes due to long standing septic conditions.

If unrecognized, or if the condition remains untreated, tumefaction in the suprapubic region simulating a full bladder develops, and either induration or fluctuation at the bladder base above the position of the prostate and vesicles. In some postoperative cases there has been an extension into the ileac fossa towards the kidney simulating the characteristic extension of urinary extravasation. Perivesical abscesses have been known to rupture into the rectum or into the bladder. Pasteau has ob-

served a bladder in which redness was present over that portion of the bladder which covered the abscess. This redness later changed to edema and the edema was followed by perforation at that spot. Extension of an abscess from the suprapubic space upwards along the course of the urachus has been noted.

The symptoms presented by perivesical suppuration vary with the causal factor. Acute symptoms are for the most part confined to those cases in which the conditions develops from recent operation, trauma, or urethral instrumentation. These symptoms are well described by Chute in his series of 5 cases reported before this society in 1922 and in one reported in 1909. Suprapubic and pelvic pain, rise of temperature, suprapubic and rectal tenderness are the chief leads in diagnosis. Bladder symptoms may be acute from fixation of the bladder from pericystic inflamation and decreased bladder capacity, or may be absent entirely. Retention from deformity fo the trigone occurs in the occasional case.

In those instances in which the inflammatory process is more gradual in its development, or in which the process develops as a part of a generalized infection as in the 2 cases reported in this paper, the bladder may be temporarily disturbed in function as shown by a short period of frequent urination and intermittntly at other short intervals during the progress of the disease. In all except the cases of pericystitis developing from severe exacerbations of pre-existing cystitis which usually means gangrenous cystitis, the bladder'urine remains unchanged. The temperature is often that of chronic sepsis with evening rises to 100° to 102°. The patient may be comfortable and only slightly tender locally.

The prognosis of this disease is grave. It is most serious where it arises as a complication of recent operation. Chute reports death in 3 of the 6 cases reported. Aversenq collected two series of cases: the first covered 125 cases with spontaneous recovery in 5 per cent and an operative mortality of 55 per cent; the second included 155 cases with a spontaneous recovery of 15 per cent and total recovery of 71 per cent for the series. It is not unlikely that the rare case of pain in the pelvis and about the perineum

following either perineal or suprapubic prostatectomy, which may last for months is low grade pericystitis. These cases eventually recover completely. Cases are reported in which satisfactory drainage of the paravesical region was not obtained. The infection proved tenaceous with intermittant sinus drainage for years following the operation.

Treatment of the condition is that of deep sepsis with adequate elimination of the focus. Most operators have expressed themselves in favor of wide suprapubic drainage with dependant drainage where possible. Where there is a tumor mass in the suprapubic region or extension along the urachus wide incision allows of proper placing of a sufficient number of drains to reach all dependent pockets. The bladder is often freed from all its attachments, except trigone and peritoneal attachments and its blood supply, distending and contracting in an abscess cavity. In such case, drainage must be made to both sides of the bladder. Hogge in his case of traumatic rupture of the urethra with pericystitis and abscess, found peritonitis and thrombosis of the mesenteric vessels. Peritoneal drainage has been found necessary in those cases with appendiceal or tubal abscesses. Such drainage was done through the suprapubic incision. Perineal drainage through the ischiorectal fossa on one or both sides as indicated is always desirable. In those instances in which the abscess has been localized high towards the space of Retzius it opens too much new tissue to infection to place perineal drains. Adequate treatment of the stricture or prostate is, of course, to be given. Aversenq prefers perineal drainage alone when possible and has done rectal puncture and vaginal puncture.

The convalescence in pericystitis is long, as a rule. The average convalescence is eight weeks for 20 cases found in the literature in which the date of recovery was given. Deep perineal tube drains are kept in for this length of time with great danger of erosion of large vessels and hemorrhage as reported by Chute.

In the 2 cases to be described below there is no etiological factor known. In the first, the diagnosis was extremely obscure and baffled diagnosticians for several weeks. In the second,

diagnosis was made only after the suprapubic tumor had developed.

Case 1. The man was a lawyer sixty-eight years of age. The history was obtained entirely from his family physician and the patient's wife.

There was no history of urinary trouble at any time in the patient's life. He had no nocturia or frequency as might be expected in a man of his age. He was accustomed to have yearly examinations made since the age of fifty years. Aside from slight degree of hypertension, nothing was ever found. The urine was negative.

Six weeks before examination, while wintering in Florida, he suddenly noted slight discomfort on urination. This symptom lasted two or three days only and disappeared, urination returning to normal. Urine examined during the symptomatic stage showed rare red blood cells and a slight amount of pus. Temperature developed immediately on the cessation of symptoms, rising as high as 102.5° falling to 99° to 100° by lysis in about one week. At this time general examination was negative. There was no signs of typhoid. The Widal test was negative.

The patient was then moved home. Since coming to Massachusetts he continued to run a septic temperature ranging from 99° as a morning temperature to 101° of afternoons. Leucocyte count 18,000 to 24,000. The pulse ranged high, varying from 110 to 140. At times the respirations were somewhat elevated but this elevation was but temporary. Transitory local symptoms and signs developed which led to tentative diagnoses of bronchopneumonia, subdiaphragmatic abscess, and localized peritonitis by three Boston consultants. Portable x-ray at the patient's bedside showed a fair plate which was negative for pneumonia and pleural effusion but showed a questionable elevation of the diaphragm on the right. The abdomen was soft and the stools were normal.

Three weeks ago the patient became mentally deranged. His strength seemed unimpaired to the extent that he employed the combined services of two nurses by day and two by night to care for him and keep him in bed. He required forced feeding.

Examination showed a man in fair condition, much overweight and combative except when drugged. General examination revealed nothing striking. The urine showed 3 to 5 white blood cells per field, no red blood cells, no sugar and very slight trace of albumin. The leucocyte count was 22,000. The prostate seemed slightly larger than

normal. Its secretions showed 10 to 12 white blood cells per field. There was a single swollen hemorrhoid which his physician stated developed within the past ten days. High above the prostate and vesicles was found a firm induration of the tissues of the pelvis. The diagnosis of pericystitis was made. Under anesthesia an observation cystoscope was passed. The bladder showed nothing abnormal. Rectal puncture of the induration was done. There was a little thick pus obtained. Fragments of inflamed tissue were stained for bacteria showing staphylococcus. A few days after operation considerable pus and blood escaped with a bowel movement. The temperature then fell to normal. Recovery was uneventful. The patient is alive still and seems none the worse for his experience. His bladder functions about the same as previous to his illness.

Case 2. The second case was that of a man of thirty-eight. He was seen in August, 1926. He is a large man, 6 feet 1 inch tall, weighing 185 pounds. His past history was negative. Five weeks previous to examination he was taken sick with headache and fever, but no local symptoms anywhere. The temperature for the first week ranged from 99.8° to 103°, with morning remissions to normal or subnormal. In the course of the next three weeks, mild symptoms suggestive of pneumonia, gall bladder infection and appendicitis developed in turn. These symptoms were of short duration, only a day or so and then disappeared. Widal test, blood cultures and x-rays of the chest and diaphragm were all negative. The white cell count ranged from 14,000 to 24,000 during this period. Bladder symptoms were present, but obscure.

At the very onset of symptoms, he complained of slight irritation in the pelvis on voiding. He was conscious of urination being abnormal, but it was not particularly disagreeable or painful. He later had an unduly great desire to void which came on suddenly. Urination was free and painless. He voided normal quantities of from 6 to 18 ounces at a urination.

When examined he seemed to be in perfect comfort. His only complaint was that he felt unduly conscious of both bowel and urine passages. General examination was negative except that there was a mass in the lower abdomen extending across the lower abdomen about 3½ inches above the symphysis, somewhat higher on the right side. This I thought to be an overdistended bladder. He then voided 10 ounces of clear urine without visibly affecting the size of the tumor mass. A catheter showed the bladder to be empty. By rectum the prostate

and vesicles seemed normal. Above the vesicles was a soft fluctuating area to the right of the midline and the whole of the pelvis was filled with a firm mass which was somewhat tender on pressure and could not well be reached. The white blood cell count was 24,800. The temperature 101.2°, the pulse 90. The abdomen was soft above the tumor mass, not tender, and there was no distension.

Diagnosis of pelvic abscess, probably paracystitis was made. The patient was moved to hospital and operated immediately. Under local anesthesia a midline incision was made. After separating the muscles there was a gush of thick yellow pus, without odor, about 2 quarts in amount. By palpating through the incision, the bladder was found to be surrounded by an abscess cavity but separated from the abdomen by the peritoneum. The blood supply to the bladder crossed the abscess cavity unsupported. Three soft rubber tubes were placed, two to the right of the bladder, and one to the left. The wound was left wide open for irrigation. Convalescence was slow. In the course of eight weeks, the abscess had drained and the wound healed. He was seen in January, 1927, in excellent health. His urine was negative.

I have taken the liberty of reporting these 2 cases before this society, because in one the symptoms were extreme, but the signs and local findings so slight as to make me uncertain of the diagnosis until the evacuation of pus several days after operation. In the other, besides the absence of any etiological focus, the symptoms were extremely mild even after a large pus cavity had formed.

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GANGRENOUS CYSTITIS

REPORT OF TWO CASES, ONE WITH EXFOLIATION OF A CAST OF THE BLADDER

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This subject was so comprehensively treated by O'Neil (1) at the 1909 meeting of this Society that the succeeding years have produced but little to add to his presentation, except in the number of cases reported. O'Neil collected 52 cases, 34 in females and 18 in males, and added a table of Haultain's cases, 53 in females and 3 in males. Miller and Wolferth (2) in 1922, reporting 2 cases of vesical gangrene with exfoliation in women suffering from typhoid fever, were also able to collect 137 cases of the condition, inclusive of 8 cases occurring in typhoid fever patients.

Two cases occurring almost simultaneously in males in the Urological Service of the Montreal General Hospital, one with exfoliation of a complete cast of the bladder, are reported because of the interesting, though distressing, sequelae.

Case 1. A male, aged forty years, was admitted March 23, 1926, complaining of pain in the bladder region and retention of urine. A consistent alcoholic, he contracted gonorrhea at sixteen, probably syphilis at the same time. In 1916 he was under treatment by a neurologist and at that time had a temporary incontinence of urine. Again in 1922, when a diagnosis of cerebro-spinal syphilis was made. Antileutic treatment was apparently not given. About February 15, 1926, he began to have increased frequency of micturition, by day six or seven times, night two or three. One month later he suffered from cramps in the lower abdomen and inability to urinate, followed by dribbling. Previous to his admission on March 23, he was catheterized once.

On admission he showed marked symptoms of mental aberration, had

delusions, the tongue dry and heavily coated, bladder distended to 2 inches above the umbilicus, the temperature being afebrile. The penis and scrotum were excoriated. Azotemia, blood urea nitrogen 48 mgm. per 100 cc., was present. A 16 Fr. catheter was passed with some difficulty, on account of strictures of large calibre. The urine was foul, contained a moderate amount of pus and much blood. Catheterization was at first fairly easy and was performed at four-hour intervals. On March 26 an inlying catheter was inserted. It showed a tendency to plug and to be forced out. The temperature from March 28 was elevated to 100° to 101°, with an occasional steeple to 103°. The blood urea nitrogen fell to normal limits, but rose again, and on April 10 was 42 mgm. per 100 cc. The urethra was gently sounded two days before to 24 Fr. In spite of this, spontaneous urination was impossible and drainage by catheter extremely unsatisfactory, the catheter plugging with pus. No membranes were passed. The urines continued to be foul and blood stained. A suprapubic cystostomy was performed on April 12, to secure adequate drainage. On opening the bladder the opening was almost immediately plugged with a soft veil of tissue, about the size of a lady's pocket handkerchief, which, on removal, proved to be an almost complete cast of the bladder wall. Several small pieces of necrotic slough were also removed. The specimen comprised almost the entire area of the bladder cavity except at the bladder neck where the specimen was irregularly notched. It was thin, on one side grayish in color, with a necrotic and sloughing appearance. The other side was redder and several tags of fibrous tissue adhered to it. On removal of the exfoliated material, the bladder cavity was so foul as to prevent any accurate observation. The bladder was drained by a moderate-sized Freyer tube suprapubically. The specimen was unfortunately not submitted to microscopical examination, was allowed to dry and was destroyed. The bacteriological report on the bladder contents obtained at the cystostomy was B. coli, Staphylococcus and B. subtilis. The patient's condition gradually improved, temperature subsided in ten days. The urethra was regularly dilated but the suprapubic wound was slow in closing. Urination was occasionally incontinent. A neurological examination showed normal serological findings in blood and spinal fluid, lateral nystagmus and bilateral intention hesitancy, all pointing to a diagnosis of disseminated sclerosis. He was allowed to leave hospital on July 20, urines clear, but with slight suprapubic leak. Alcoholic intake was promptly commenced, two days later he was readmitted, markedly

azotemic, blood urea nitrogen being 60 mgm. per 100 cc., with clouded mentality and with incontinence of urine and feces. Under inlying catheter drainage, glucose salines intravenously, etc., he gradually improved. Urethral dilatation was later resumed and difficulty in inserting the instrument past the prostatic urethra was always noted. A cysto-urethroscopic examination on October 25 revealed a markedly dilated pouch behind the verumontanum, a diaphragm of tissue separating this from the bladder. A band of tissue fixed at either end passed across the pouch. The bladder itself was markedly pale, except over the trigone, which was deeply congested. A cystogram on this date showed a slight ureteral reflux of the left ureter. The upper border of the bladder shadow was irregular in contour.

On November 1 the suprapubic fistulous tract was dissected out and the bladder opened. A sound was inserted into the urethra and under the thin diaphragm, which was slit on the sound, the band being cut at the same time. Wide separation of the flaps was at once noted. A second cystogram made a few days before his discharge on December 3, 1926, showed a much more marked condition of bilateral ureteral reflux, with distended ureters and kidneys, the bladder showing an irregularity of its contour similar to that noted in the previous cystogram. There was a slight transient leakage through the wound three weeks later, lasting a week. Hospitalization was again required from January 19 to February 21, the wound reopening again. Regular urethral dilatations to 26 Fr. were followed by apparently permanent closure. From that time he has been under observation in the Outdoor Department with gradual improvement in symptoms.

Case 2. A male, aged twenty-nine years, who, while receiving treatment for a gonorrheal infection of ten years' duration, underwent a cystoscopic examination by a cystoscopic aspirant. There is a strong suspicion that the fluid used to distend the bladder was a strong mercuric perchloride solution. Immediately following the examination he complained of frequent and urgent urination, hematuria, pain over the suprapubic region and the right renal area, radiating down the right side to thigh and scrotum, all apparently without febrile reaction. Ten weeks later, on September 30, 1926, he was admitted to the Indoor Urological Service of the hospital.

Physical examination revealed normal temperature, slight tenderness over right kidney region and resistance and tenderness suprapubically. Chronic prostato-vesiculitis. The urethra showed a stricture of moderate

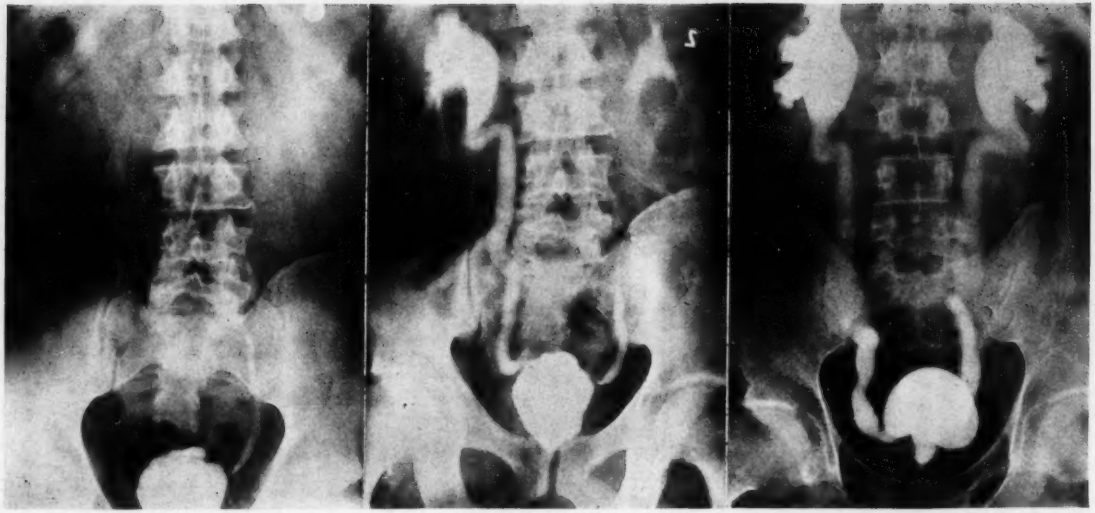

FIG. 1 FIG. 2 FIG. 3

FIG. 1. CYSTOGRAM, CASE 1, SHOWING SLIGHT URETERAL REFLUX AND IRREGULAR CONTOUR OF THE BLADDER

FIG. 2. CYSTOGRAM, CASE 1, ONE MONTH LATER, SHOWING MARKED BILATERAL REFLUX

FIG. 3. CYSTOGRAM, CASE 2, SHOWING BILATERAL URETERAL REFLUX, MARKED DILATATION OF URETERS AND KIDNEYS AND IRREGULARITIES AT BLADDER NECK

tightness in the bulbous urethra. Wassermann negative. X-rays negative. Urination was extremely frequent and painful. Urine 1022 alkaline, albumin one plus, moderate pus, red blood cells one plus. Cystoscopy, October 4: "Bladder contained much phosphatic debris and a few concretions. Mucosa deeply congested on its right side and over the vault, covered with a greyish slough." Later he passed two phosphatic concretions about the size of a split pea. Cystoscopy, October 6, showed an even more "congested vesical mucosa; floating about the bladder or attached were calcareous fuzzy masses, mainly over the vault and obscuring the ureter orifices."

No improvement resulting from treatment, the temperature remaining afebrile, on October 9, cystostomy was performed. On opening the bladder, blood-stained fluid escaped containing small calculous particles. The bladder mucosa was widely exposed. It was intensely inflamed, scattered over its surface were patches of greyish slough, impregnated with a loose calculous material, the patches varying in size from 1 to 3 cm. Some patches were intimately adherent, others partly loosened, while others were free in the bladder cavity. Between the areas of slough there was a productive inflammation, with flat granulations. The area about the trigone and right ureter orifice was most involved. The bladder was drained by a Freyer tube. Bacteriological report on bladder contents: "A mixed growth of Staphlococcus albus, Gram-negative cocci, and Gram-positive rods." Through the bladder drain, for about a week, masses of sloughing tissue were passed. One week after operation there was a fairly free hemorrhage, after which the fluid was clearer. Drainage was maintained for sixteen days. He voided on the twentieth. The suprapubic wound showed no disposition to heal and if dry for a brief period would promptly reopen. Residual urine varied from 50 to 110 cc. Regular urethral dilatation was instituted. A cystogram on December 5 showed a bladder of irregular contour, marked reflux and dilated ureter and kidneys. Cystoscopy February 5 showed a contracted bladder outlet with an undermined pouch in the prostatic urethra below the inferior aspect of the bladder orifice. February 22, the fistulous track was dissected out and the bladder and its outlet examined. The bladder wall was smooth, its cavity separated into loculi by tight fibrous bands. The outlet was contracted. Its lower aspect was incised into the pouch in the prostatic urethra. The bladder was completely closed with inlying catheter drainage.

Since that time there has been slow improvement. The suprapubic

wound has occasionally broken open. There was a definite inflammatory attack in the right kidney in March. For the past three or four months there had been a noticeable pain in one or both kidneys with the act of urination. Residual urine has averaged 100 cc. The urine has been fairly clear with a faint trace of albumin and the centrifuged specimen showing on an average from 1 to 10 pus cells per high power field. A cystogram taken on April 23 revealed no improvement in the condition at the neck of the bladder, the ureteral reflux and the dilated ureters and kidney pelves.

REMARKS

The question will at once arise whether the obstructive condition at the bladder neck, with the incapacitating ureteral reflux, resulted from the intense cystitis complicating the urethral strictures, or whether these conditions were partially or completely present before the infection, in which event they would serve as factors aggravating the infection. In the first case there are good reasons for suspecting their presence anteriorly, in view of the earlier diagnosis of a cord lesion, and urinary disturbances and the evidence on admission of renal involvement. In the second case the likelihood is much less, his previous history being that of a banal chronic gonorrhoeal urethritis. The extreme aggravation and persistence of urinary symptoms in both cases, after the subsidence of the acute infection, leads one to believe that in the main, the posterior urethral block and the bilateral ureteral reflux followed the cystitis. It is interesting to note that O'Neil (1) in his first case noted the presence of a "widely dilated" ureter after the bladder necrosis and "large cavernous ureters, very distinct" in his second case. Prigl (3) made a similar observation in his case and stated that one ureter opening resembled a diverticulum. Stoeckel (4) states that the ureters in his first case were two deep funnel shaped openings from which urine trickled without contractions. In a second case, observed one year and nine months after the necrosis, the ureter orifices were "two large smooth-walled cavities." In a third case (5), reported subsequently, of gangrene of the bladder following childbirth, the same permanent relaxation of a ureter orifice was noted.

The writer is unaware of any reported cases of this complication having been subjected to examination by cystography. The presence of such reflux explains how subject such cases are to pyelonephritis, which must remain the greatest danger in patients who are fortunate enough to recover from the gangrenous or necrotic process in the bladder, particularly when obstructive factors are still present at the vesical outlet. That such permanent mechanical disturbances result is not surprising, in view of the destruction of musculature of the bladder, particularly about its three orifices and its replacement by scar tissue.

There would seem to be nothing remarkable in the production of gangrene in a very acute cystitis. As Guyon (6) remarks "gangrenous cystitis is not a separate variety of cystitis, but merely an acute episode in a particularly severe chronic cystitis." More remarkable is the fact that it does not occur more frequently in virulent infections in a hollow viscus, subjected so frequently to obstruction of its outlet, with associated factors of retention and trauma aggravating the infection. That it is more common in women is due to the factors present in that sex, incident upon childbirth, where traumatism and long-continued pressure on the bladder and its circulation are frequently present.

In both cases here reported the necrotic process seems to have resulted from severe cystitis. Retention followed in one, the result of plugging by the exfoliated mass. It was absent in the other case. Both men were possessors of urethral strictures, the result of old gonorrheal infections.

In one case there is a possibility of a strong bichloride solution having been used, though it is unlikely the dilution was stronger than 1:1000. Such a causative agent is not a rarity among the cases reported. Prigl (3) reports one such case in which a 1 per cent solution of bichloride was used. Vinegar and ammonia were used in efforts to induce abortion in two cases reported by Mock (7). Other observations of a similar character are quoted by Legueu (8).

From the therapeutic point of view, one should endeavor to catheterize regularly all cases of cystitis with retention. Where this is difficult on account of plugging of the catheter by slough

and membrane, cystostomy should be performed and adequate drainage given. While spontaneous cure may be possible in the exfoliation cases in women, this is less likely in males; in fact only one cure is reported (9). Where recovery from the acute infection follows, in view of the probability of distortions and contractures of the vesical orifices and of the bladder itself, careful observations should be made and any obstructive factors in the lower tract removed or palliated, together with prophylactic treatment against the otherwise inevitable renal infection.

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DISCUSSION

Dr. NATHANIEL P. RATHBUN (Brooklyn): I believe the rôle of the seminal vesicle as a possible factor in the etiology of some of these obscure cases of pericystitis should be emphasized. I think that vesiculitis and infections of the seminal tract in general occur rather frequently in non-venereal cases. The first and sometimes only symptom is dysuria and retention of urine. I think some of these cases go on to suppuration. I think usually the pus extends downward into the ischiorectal space. It may extend in another direction. I am sure you are all impressed by the fact that ischiorectal abscesses are very rarely present in the female and many of these cases are noted in the male.

Dr. JOHN R. CAULK (St. Louis): My initiation into urological surgery was along the pericystic path. While an intern in the Johns Hopkins Hospital, a resident surgeon turned over a supposed double bubo for me to operate upon. I recovered an enormous amount of pus which was then followed by a flood of water. This terrified me until I found it was due to a rupture in a prostatic abscess with the seat of rupture near the bladder. Both pus and urine had extravasated in the perivesical space.

There are many points which have been brought out in these papers which are exceedingly interesting. We are all impressed with the frequency of the internal genital tract as a cause of suppurative conditions around the bladder, acute suppurative conditions, much more commonly than from lesions of the bladder itself. Bladder lesions are much more likely to be thought of in connection with chronic suppurative infections.

The fact that catheterization of the bladder does not cause the mass to disappear is very significant. What is striking in the cases reported and the cases which I have seen is that the leukocyte count of 24,000 seems to be the count. Almost every one mentioned in the literature has been this number.

Concerning Dr. Patch's paper on "Gangrenous cystitis," I have seen several cases; one in a tabetic and one in a cancer of the bladder, and this cancer of the bladder had a spontaneous rupture, and one, the result of sodium hydroxide being put into the bladder. This woman had reflux up the ureters which had not been present beforehand. The urologist who had cystoscoped her previous to the accident found her ureters normal. It was a case which I reported before this Association, of an hour-glass bladder, some years ago. Reflux up the ureters in central nerve lesions, at least in my experience, is less frequent than in mechanical obstructions because, as Graves and his co-workers have shown, tonicity is paramount, and here tonicity is not present to as great an extent.

Dr. J. Dellinger Barney (Boston): Dr. Culver's very interesting paper recalls a case which interested me from two points of view, which I think is worth mentioning.

One day last winter, a middle-aged man with his doctor came into my office unexpectedly. The story was that this man had been off on a spree a little while before and this had resulted in a good deal of bladder disturbance. He was quite sick, had a temperature of 101°, with much frequency, and the urine was clouded with pus and some blood. Examination showed a good deal of induration and tenderness over the pubes. Rectal examination showed nothing very remarkable. I cystoscoped him as best I could in the office with a small cystoscope and saw a very red and edematous mucosa occupying entirely the roof of the bladder.

It looked to me very much like an acute inflammatory process induced by his alcoholic excess, and so forth, and incidentally he had had innumerable attacks of gonorrhea. I was going away at the time, so I told the doctor to put him to bed with constant catheter drainage and hot fomentations to the abdomen and hot vesicle irrigations, with instructions to call another surgeon, if necessary.

I went away at that time and when I came back I found that although the man had improved considerably for about a week

in every respect, he then got worse. Another man was called in, and to make a long story short, opened the bladder and found an infiltrating carcinoma of the dome of the bladder. The patient had since died. It was apparently a very extensive process and undoubtedly existed at the time that I saw the patient. I only saw him once and was not able to do very much, but I think it illustrates the fact that these cases may be a little confusing at times.

Dr. FRANCIS R. HAGNER (Washington): I think that among other causes of perivesical suppuration is that following an abscessed testicle. We have had two of those cases where the patient had abscessed testicle with involvement of the tunica vaginalis, due to colon infection, subsequently that patient developed a perivesical suppuration.

I am very much interested in Dr. Patch's paper on "Gangrenous cystitis." Some years ago we reported a case, the second case up to that time that had ever recovered in the male. Previous to that time all of the cases had died. This old gentleman was a very interesting character, old Captain Metz. He had had urinary retention over a considerable period of time and when he came to us he had over two quarts of retained urine. The bladder was so gangrenous it looked like the inside of a derby hat when we cystoscoped him. He made a wonderful recovery. The whole cast of the bladder came out after drainage and this old fellow had a perfectly normal result after removal of his prostate; he had good capacity; I do not know whether he had regurgitation in the ureter or not. He made a good recovery. He had a large amount of urine in the stretched bladder and consequently he did not have a contracted bladder. He was about seventy-two or seventy-six years old when operated, and he died last year at the age of eighty-six years.

Dr. WILLIAM C. QUINBY (Boston): There are two points that I would like to mention in regard to these two very interesting papers. One, in regard to such cases as were described by Dr. Crabtree, to suggest that there is a possibility of the condition

being due to a low pelvic diverticulitis; that is, that the suppuration may have origin in a diverticulum of the intestine, rather than in the urinary tract primarily. Such diverticula occur in widespread areas of the bowel, and if in certain instances they be found very low and not very acute, with a low-grade adhesive peritonitis and a matting together of the omentum, one gets just this picture; to be sure, primarily intraperitoneal but at a little later stage extraperitoneal, extraperivesical.

In regard to Dr. Patch's communication, my experience with it has been limited to, I think, four cases, and I have felt that where there has been a sufficient degree of inflammation to cause a sloughing out of the mucous lining of the bladder, that inflammation must be of such an extent as to cause a widespread interstitial cystitis. Under these conditions, it is almost axiomatic that the ureteral valve will be markedly deformed.

Dr. Edward L. Keyes (New York): Dr. Culver spoke of the difficulty in identifying the cause of so-called spontaneous pelvic abscess. I agree with some of the other speakers that so-called metastatic prostatitis may well be that cause. It has seemed such in some of my cases. He spoke of preliminary suprapubic drainage in order to prevent abscess following upon extensive suppuration. I should think that might be amended to cover only those cases which had extensive suppuration which would not be relieved by extensive drainage. He spoke of ascending renal infection. I should think it doubtless descending.

Dr. Andrew J. Crowell (Charlotte, N. C.): I think Dr. Culver was very fortunate in the results obtained following drainage through the rectum in his case of perivesical suppuration. Personally, I would hesitate very much to drain any perivesical abscess through the rectum. They can be drained better by placing the drain perivesically and thus avoid the danger of blind internal fistula and recurrence of perivesical abscess; which is almost certain to recur.

Dr. Arthur L. Chute (Boston): I am very much interested in these perivesical suppurations. I have seen one in which the

perivesical suppuration extended up to the region about the kidney on the left side. This followed a prostatectomy which it did not seem to me had been done in quite the orthodox manner. This man died quite promptly.

Dr. Culver spoke of the use of irrigation in these cases. I wonder if it is wise. It seems to me if one provides sufficient dependent drainage one can get along without irrigation and probably get along better. I am of the opinion that suppurations of this type are in all probability much more common than we suppose. Since my last paper on this subject, I have seen one that I assumed was a perivesical suppuration in a girl of eighteen. She had a complete retention of her urine, her bladder contained a quart or more of urine, which was apparently due to a suppuration about the bladder. There was a place that we found that was rather thin near the vulva which I opened and let out an enormous amount of pus. She was very septic and hung in the balance for a considerable time, but eventually she made a good recovery.

I have likewise seen within the last three or four years, two men who I believe had relatively limited perivesical suppuration. However, I could not at any time get sufficient symptoms to warrant me in exploring and therefore, did not do so. Both of these men went down hill and died.

Dr. Crabtree's first case reminds me of a type of disease that we used to see occasionally when I was a house officer, where an unrecognized appendix had gone on to the formation of a big pelvic abscess. These patients were occasionally tapped through the rectum and a certain number of them got well. I do not remember whether or not Dr. Crabtree said that the appendix had been removed in this case, but the history and the findings suggest to me a condition that we used to see a good many years ago.

Regarding the case about which Dr. Patch spoke, in which Dr. O'Neil and I were interested; that woman when last seen in 1911 had ureters that were more or less patulous. No ureterograms were made, therefore, we have no knowledge as to how far the ureteral dilatation extended. In one or two places there

were patches of mucous membrane, but for the most part her bladder was one white, glistening mass of scar tissue which would hold not more than four ounces of fluid. She could not hold urine longer than an hour at a time.

Dr. HARRY CULVER (Chicago) (closing): In answer to Dr. Crowell, the first case was drained through the ischiorectal fossa, together with suprapubic drainage, but not through the rectum.

Dr. E. GRANVILLE CRABTREE (Boston): I think probably Dr. Crowell's question referred to the first case that I reported, which was drained through the rectum. There is just one answer to that question, and that was one look at the man at the time operation was contemplated.

In the case to which Dr. Chute has referred as having his appendix still in, no operations had ever been performed on this patient; he was considered a perfectly healthy man until these symptoms of continued frequency developed.

IV. STUDIES ON THE URETER AND BLADDER WITH ESPECIAL REFERENCE TO REGURGITATION OF THE VESICAL CONTENTS

THE BLADDER PRESSURE-CURVE IN THE HUMAN

ROGER C. GRAVES

From the Urological Clinic of the Carney Hospital, Boston, Massachusetts

Regurgitation from the bladder into the ureters, under normal anatomical conditions at the uretero-vesical junction, has long been a subject of experimental interest. Stimulated by the initial reports of Semblinow, in 1883, various investigators since that time have been able to observe such reflux, occurring in normal laboratory animals. My own contributions to the subject have been published in a series of studies that you are familiar with and that were first reported before this Society in 1923. In these papers we have demonstrated, beyond question, I believe, that regurgitation is an experimental fact and we have defined the conditions underlying its occurrence. Of these, may I remind you in review, that the one fundamental requisite is a sustained tonic contraction of the bladder musculature as it actively resists distention. Atonic bladders never regurgitate; post-mortem experiments are futile. Moreover, as we have shown, there are no intrinsic anatomical differences such as have been claimed, between the uretero-vesical relationship of the laboratory animal and that of the human.

As a result of these efforts and those of other investigators, there has been in recent years an awakening of clinical interest in bladder regurgitation because of its very obvious bearing upon the subject of ascending kidney infections. The *clinical* evidence upon which to base this interest, however, has thus far been meager. Except for the observations of Kretschmer, made in the course of a study of normal cystograms, in 1916, there have been presented but few positive facts derived from the human

to support a clinical theory of regurgitation. This lack of proof has resulted in a measure of natural skepticism on the part of some who have found it difficult to accept as final for the human the physiology of the dog, or the cat, or the rabbit, cogent though the arguments may be.

Recognizing this point of view, I have been interested for some time in an attempt to add evidence based on human observations to further establish what I believe to be the fact that regurgitation occurs in the human in the presence of obstruction at the bladder outlet. Unfortunately there are more than the usual difficulties in the way of such an attempt. The opportunities that exist in the laboratory for direct observation of the urinary organs, are not available in the clinic. The use of the x-ray to photograph the bladder, distended with an opaque medium, suggests itself at once as an ideal solution of the difficulty. Kretschmer's series of cystograms is very stimulating many of his plates showing as you recall unmistakable regurgitation into normal ureters from normal bladders. This method does not lend itself, however, to routine use; and, which is worse, it does not offer a decisive answer to the problem. Bladder filling, if we are to simulate physiological conditions, requires a considerable period of time for its completion. A given x-ray exposure accounts for but a few seconds of that time. Moreover, the reflux that we are studying may be but partial, with the escape of but a small amount of bladder fluid into the ureter which in turn by vigorous peristaltic activity may quickly drive it out again. Failure to picture regurgitation in the plate therefore cannot be accepted as satisfactory proof that it has not happened or that it might not occur if the distention were continued to a higher level.

The fluoroscope, by means of which we have been able to visualize regurgitation in normal intact unanesthetized animals, also suggests a method suitable for clinical use. Here again, however, there are handicaps that militate against successful results. I have used the fluoroscope with human subjects in a few instances and I have been able to see regurgitation under these circumstances. It was not possible at the time to catch

the phenomenon in the fixed impression of a plate so that I gained but further proof for my own satisfaction. The lumen of the ureter, lying deep against the posterior body wall, is relatively small and the amount of opaque fluid gaining access to it through reflux may be but slight. Except in very thin subjects, therefore, it is exceedingly difficult to visualize with any degree of accuracy.

In the face of these obstacles, which should not yet be accepted as insurmountable, there is still another plan available which seemed to me to give promise of contributing further to this subject. The prolonged studies that have been made in the laboratory have established certain fundamental and now well-recognized facts concerning the physiology of the bladder muscle and its reaction to distention, particularly with reference to regurgitation. To quote from a previous paper:

> There is an initial vermiform activity of the filling bladder caused by rhythmic contractions of the musculature stimulated by gradually increasing distention. As the upper limits of intravesical tension are approached, these rhythmic movements cease to be apparent and in their stead occurs a sustained contraction of the bladder wall upon its contents. It is in this tonic state that pressure within the bladder rapidly rises until such levels are reached as render regurgitation possible.
>
> In the period of rhythmic activity, the muscle fibers are lengthening as filling proceeds. The intermittent contractions represent a sort of clonic response to the stimulus of stretching or distention. Later, further stretching is continuously resisted, and the state of tonic, sustained contraction is reached. In other words, the bladder at first responds to the gradual filling, isotonically, that is by increasing the length of the muscle fibers without changing the tension (except for the periodic contractions described above). Finally, when a sufficient quantity has been introduced, the response becomes isometric; the fibers maintain the same length and respond to the stretching force by a rapidly increasing tension.
>
> Our experiments demonstrate the fact that regurgitation is attained most rapidly or with the smallest quantity, in those bladders in which the response tends to be isometric from the start. In some cases tone was so active and the isometric state was reached so soon that inter-

mittent contractions were not observed at all, and in these cases reflux pressure-levels were developed with surprisingly small quantities of fluid. In other instances, however, and indeed in the majority of the experiments, a rhythmic activity preceded the final tonic resistance to filling. A third type of bladder occurred, so lacking in tone, that muscular contractions failed to appear at all, or did not get beyond the rhythmic state. These bladders presented no active resistance to filling and in them the pressure finally engendered was purely a passive, me-

FIG. 1. TRACING OF THE RISE OF INTRAVESICAL PRESSURE IN THE CASE OF A NORMAL DOG IN WHICH BILATERAL REGURGITATION WAS OBSERVED

Dog 37 R. May 6, 1922. The bladder was slowly filled with physiological salt solution at body temperature. The active resistance to distention in this case, with resulting rapid rise of pressure is comparable to that characteristically present in the rabbit and cat. The arrow marks the time of bilateral reflux (175 cc. in the bladder; pressure 100 mm. Hg).

chanical tension produced because the sac could hold no more. In such cases, regurgitation never occurred.

In general then it may be stated that there are two groups of bladders so far as the reaction to distention is concerned. One group, marked by an active state of muscle tone, resists distention and in these, tracings of intravesical pressure show a constant, relatively rapid rise of tension as filling proceeds (fig. 1). Such bladders will regurgitate, when the normal outlet is obstructed,

in a large percentage of cases, as we have demonstrated in a long series of animal observations. The other group, relatively lacking in tone, consists of bladders that offer feeble or no resistance to the force of distention. These bladders fall away from the distending fluid and there is no appreciable sustained rise in intra-vesical pressure until the end stage of filling is reached when, as has been said, there is developed a purely mechanical tension produced because the sac can hold no more. With bladders of this passive type, regurgitation never occurs (fig. 2).

As we are dealing with fundamental reactions of smooth muscle, it seemed reasonable to expect in starting this particular investi-

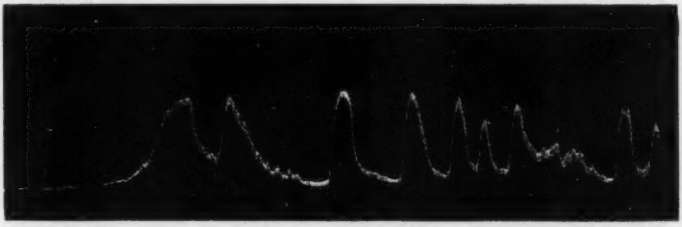

FIG. 2. TRACING OF THE INTRAVESICAL PRESSURE IN A GRADUALLY DISTENDED BLADDER OF THE PASSIVE TYPE

Dog 21 R. April 7, 1922. Note the absence of sustained contraction of the bladder musculature and the consequent inability to maintain the higher levels of intravesical tension. Regurgitation did not occur.

gation that the human bladder, so far as its behavior during distention is concerned, would fall into one or the other of these groups and so give us further evidence to support or deny the clinical theory of regurgitation. To answer this phase of the question, I have made use of an instrument which has just been completed and which makes it possible to accurately record the development of intra-vesical pressure during bladder filling. This apparatus was made by the Sanborn Company for D. K. Rose of St. Louis, who has recently published a report of his valuable studies on pressure curves in various types of human bladders with particular reference to the diagnosis of disturbances

of innervation. The instrument consists of a reservoir from which the bladder may be filled with a definite volume and rate of speed through the action of a small piston pump. There is also a mercury manometer which communicates with the recording device and which is in open communication with the bladder cavity throughout the period of filling. Geared to the pump is a

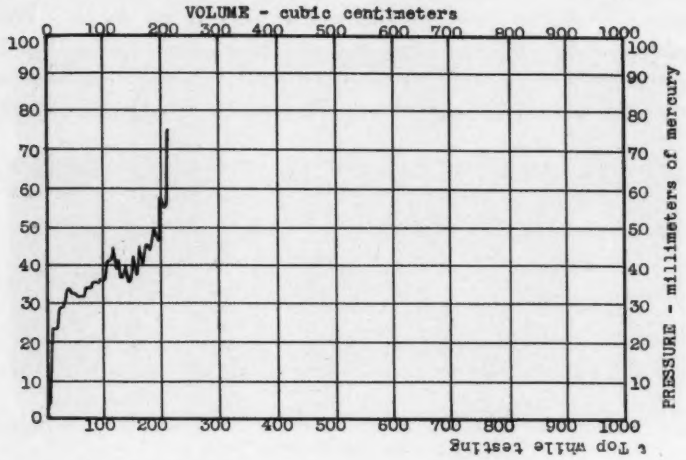

FIG. 3. TRACING OF THE RISE OF INTRAVESICAL PRESSURE IN THE HUMAN

Compare with figures 1 and 2. The bladder was slowly filled with physiological salt solution at body temperature. Note the active resistance to distention evidenced by the rapid sustained elevation of pressure.

Case of George C., aged eighteen, April 21, 1927. Convalescent tonsillitis. Temperature normal for four days. Urine normal. The bladder was not emptied before the test and 450 cc. were voided at the end of the experiment; pressure 75 mm. Hg.

small kymograph which provides the permanent record of the manometer as it registers the changes in intra-vesical tension.

The experiments have been made at the bed-side. The patients have had no sedatives and neither local nor general anesthesia. I have made use of a two-way woven-silk Coude catheter of size 18 or 20 Fr. This is easily passed and is retained by the average patient without discomfort. There has been

no effort to bind it to the urethra to hold it in place. The two-way catheter, one-half for the fluid inlet and the other half in communication with the manometer, makes possible uninterrupted pressure readings during the course of the experiment. Normal saline has been used for filling in all cases and the solution has been heated to reach the bladder at body temperature. The rate of fluid introduction in these first observations was about 20 cc. per minute. The patients were instructed to lie

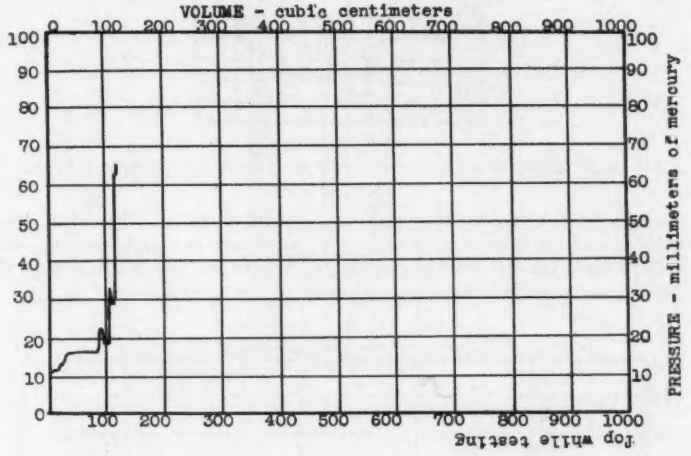

FIG. 4. TRACING OF THE RISE OF INTRAVESICAL PRESSURE IN THE HUMAN

Case of Antonio S., aged forty-five. Convalescent pneumonia. Lungs clear. Temperature normal. Urine and blood normal. The patient did not coöperate well, and voided around the catheter at 125 cc.; pressure 66 mm. Hg.

quietly with the hands at the sides and to breathe with the mouth open to minimize the influence of the diaphragm and the abdominal muscles. In each case filling was continued until the patient complained of an impelling desire to void or until the bladder began to empty itself around the catheter.

As has been stated, this work was started to obtain a record of the characteristic pressure-curve of the human bladder and for the sole purpose of comparing that curve with certain stand-

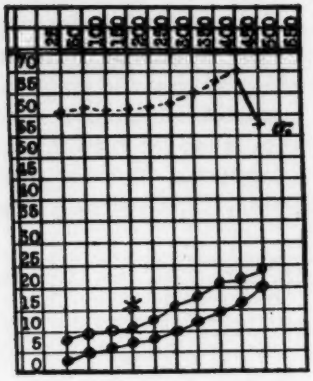

FIG. 5. BLADDER PRESSURE-CURVE IN THE CASE OF A NORMAL MAN, AGED THIRTY

The first desire to void is marked by the asterisk at 175 cc. The bladder was emptied around the catheter at 450 cc. The line of solid dots represents the pressure engendered by the bladder wall alone, without the active influence of the diaphragm and abdominal muscles. (Courtesy of Dr. Rose.)

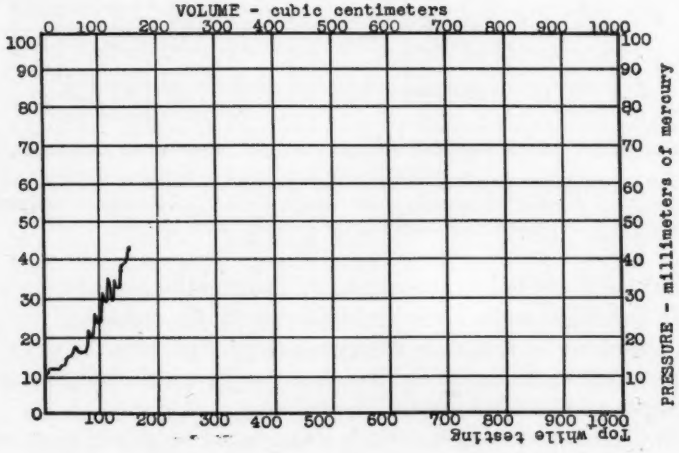

FIG. 6. PRESSURE TRACING IN A CASE OF PROSTATIC OBSTRUCTION WITH CYSTITIS

ard types of pressure reactions that have been evolved in the laboratory. This must of necessity be a preliminary report because in the short time since the apparatus became available only a few observations have been possible. Thus far, it may be stated, however, that I have found but one case—a patient with long standing stricture and infection—that would not be classified beyond question with the active tonic group of bladders that I have described experimentally and that permitted reflux in so large a percentage of cases. Through the generous courtesy

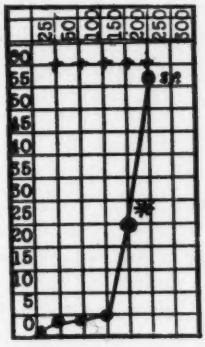

FIG. 7. TRACING OF THE RISE OF INTRAVESICAL PRESSURE IN THE HUMAN

Case of prostatic obstruction with 800 cc. of infected residual urine. Note again the active type of bladder resistance to distention. Such pressure curves, experimentally, have been found to be consistent with a high incidence of regurgitation. (Courtesy of Dr. Rose.)

of Dr. Rose, moreover, I am permitted to comment from this point of view on the human pressure-curves that he presented in his recent paper. In this series, except for the atonic bladders of spinal-cord disease, there was none of the passive type. With your permission, I will show you slides which illustrate the active animal bladder from which regurgitation readily takes place, the passive animal bladder from which regurgitation is not to be expected and the characteristic human pressure-curves which place the human bladder in the active group.

I am fully aware that this is argument by analogy but I submit

it as at least added evidence to support the contention previously made that regurgitation into the ureters may occur in the human in the presence of vesical-neck obstruction.

I wish to express my appreciation of the invaluable assistance of Dr. Henry A. Kontoff, in making these clinical observations.

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UROLOGICAL COMPLICATIONS FOLLOWING FRACTURE OF THE SPINE

CASE REPORT

VINCENT J. O'CONOR

Chicago, Illinois

The history which follows is of interest as it illustrates the various urological problems involved in the prolonged observation of a patient who had suffered extensive spinal injury.

Francis D., a brakeman, aged twenty-four years, was crushed between an engine and a freight car on June 25, 1920. He was taken to a small town nearby and was placed in a hospital where morphin was administered freely for several days to control his pain. At this time the right thumb, index and middle fingers were amputated because of injury. On examination it was found that there was complete paralysis of the lower limbs. For forty-eight hours after injury there was a complete inability to urinate, but his general condition was so critical that the patient did not recall any discomfort in the bladder region. On the third day incontinence developed and there was a constant dribbling of urine. By the seventh day after injury the condition had improved and with the aid of enemata the patient's elimination was sustained. At this time he was seen by another doctor who advised catheterization of the bladder although the patient later stated that he had no discomfort in this region other than the annoyance of a constant dribbling.

Following the second catheterization the patient experienced a severe chill and for several days the temperature was greatly elevated. From this time on the patient suffered a constant sense of bladder discomfort and it was necessary to relieve him every four to six hours by catheterization of the bladder.

From this history, which was very carefully taken, it would seem that for five days the patient had gotten along nicely by developing a paradoxical paralytic incontinence of urine and that

catheterization precipitated a very acute urinary infection. Although it may have had no bearing on the final outcome a description of the technique involved in this procedure was decidedly other than aseptic. Of course the patient's ideas on this subject were not entirely trustworthy. In any event the urinary excretion which previously had given no other discomfort than the constant dribbling now became the most troublesome part of the patient's condition and caused him even more pain and discomfort than the site of his injury.

The patient was brought to the Washington Boulevard Hospital at Chicago on July 14, 1920 (three weeks after the injury). X-rays of the spine on July 15 showed "markedly comminuted compression fracture of the second lumbar vertebra, with displacement to the left of the lower fragment and the lower lumbar vertebra for a distance of about 4 cm. The left transverse process of the third lumbar vertebra is fractured."

On July 16, 1920, laminectomy of the first, second, and third lumbar vertebrae was performed by Drs. Lounsbury and Metz. There was an excellent operative recovery and on July 17, 1920, x-rays made with a portable apparatus were reported as "Film after operation for laminectomy shows extensive destruction of the second lumbar vertebra with evidence of good callus formation about the fracture. The region of the right kidney is occupied by numerous small shadows which appear to be calculi from 1 to 3 mm. in diameter. The region of the bladder shows numerous small stones and one large one."

On August 7, 1920, the patient was able to move toes and feet and his general condition was good. Catheterization had been done every six hours. Many small stones were voided by the patient on several occasions. The condition gradually improved and in October the patient was able to sit up in a wheel chair. At this time he was reported as urinating every two hours but catheterization done twice daily showed from 20 to 30 ounces of foul residual urine.

I was first called to see the patient on November 9, 1920, during an attack of acute renal colic with vomiting and temperature 104°F. At this time x-rays showed both kidney regions mottled with shadows and from twelve to fifteen shadows in the bladder region. The two-hour phenolphthalein test yielded less than 5 per cent. The blood urea nitrogen was 92.5 mgm. per 100 cc. and there were 900 cc. of foul, thick residual urine. The blood pressure was 135 systolic and 90 diastolic.

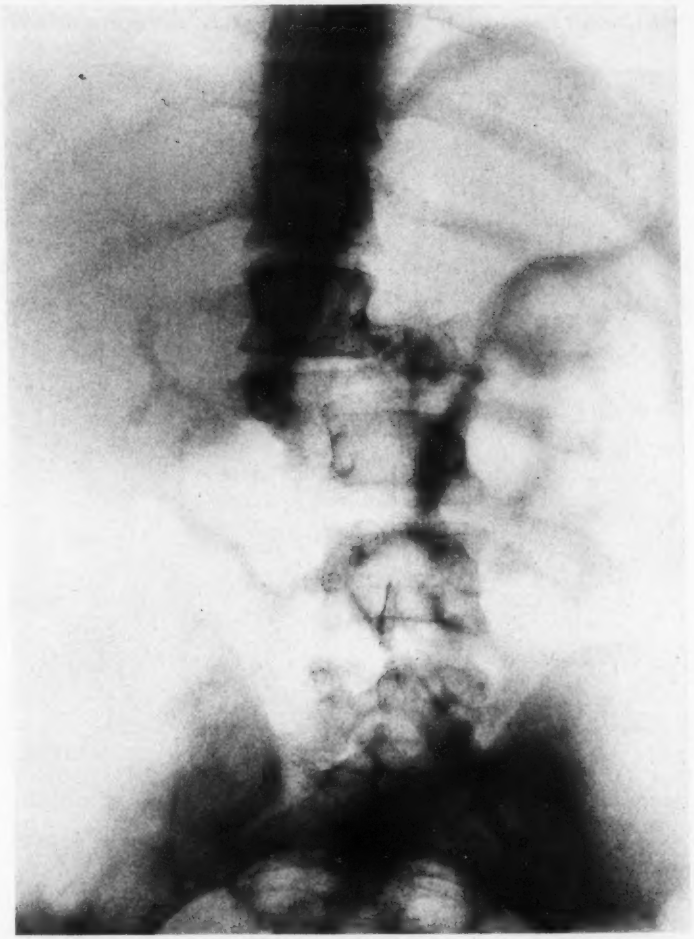

FIG. 1

An indwelling catheter was placed in the bladder and bladder irrigations were done twice daily. In two days the temperature returned to normal and pain ceased.

The urine cleared up considerably after a three weeks' period of constant bladder drainage, but further investigation was deemed inadvis-

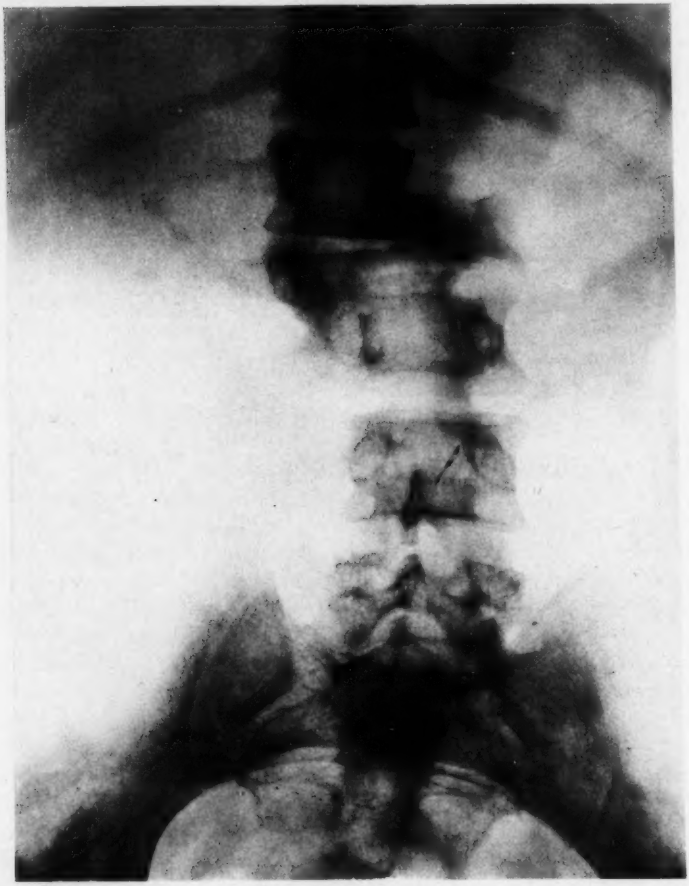

FIG. 2

able at this time. In February, 1921, the patient was able to stand with the aid of support and from then on made rapid improvement being able to walk with crutches in March, 1921. During March the patient

was cystoscoped three times and by means of the cystoscopic rongeur and lithotrite some fifteen bladder stones were removed. The intense

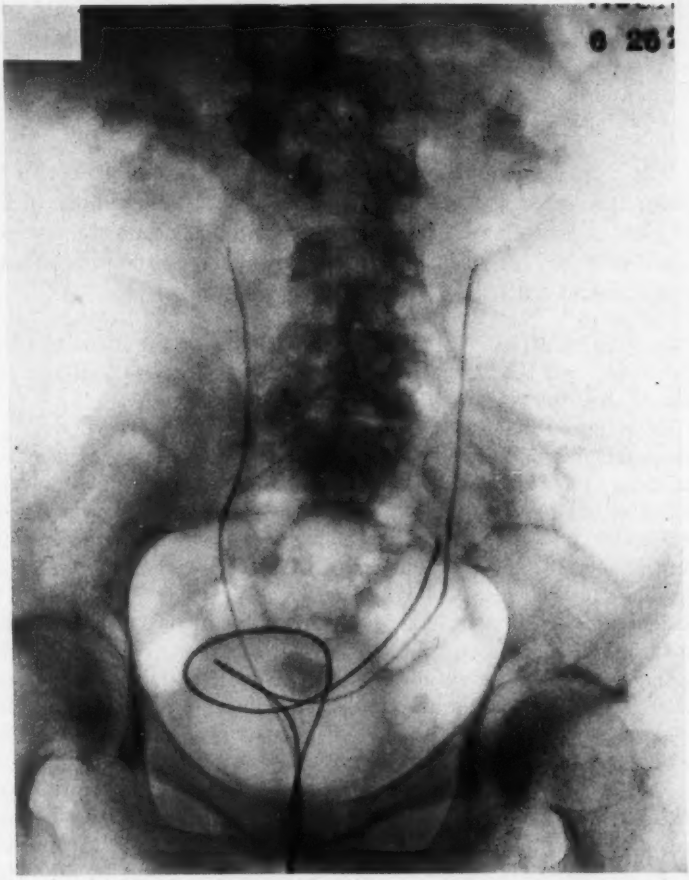

FIG. 3

inflammation of the bladder wall made identification of the ureters impossible. March 14 the blood urea nitrogen was 87 mgm. and the non-protein nitrogen 142 mgm.

During April, 1921, the patient had numerous attacks of renal colic but ability to void constantly increased so that the residual decreased to an average of 300 cc. During May twelve bladder stones were removed after crushing with the lithotrite.

In May, 1921, the patient was very active on crutches, eating well and had gained 20 pounds in weight. His blood urea nitrogen was 95 mgm. and his phenolphthalein the faintest trace. The blood pressure was 120/90.

The adjusters for the railroad company wanted to settle the claim and asked for a prognosis as to his probable length of life. In view of the severe urinary infection and the persistently high blood nitrogen retention I thought that from six to nine months was a liberal outlook.

In May, 1921, the patient received a lump sum settlement of his claim, declared that he was well enough to go to Nebraska and purchased an automobile in which he drove away.

He returned in June stating that he had driven his car over one thousand miles and that his only complaint was frequency of urination and pain in the bladder. At this time the residual urine was only 150 to 200 cc. but very turbid and foul. The blood urea nitrogen was 91, 92.5 and 93.5 mgm. on three successive days. At this time six stones were removed from the bladder and the patient was kept on an indwelling urethral catheter for two weeks. Cystoscopy then showed no bladder stones. Two ureteral orifices were identified on the left and one on the right. Catheterization of the three ureters gave equally thick purulent urine from each and no trace of dye from either side in one hour. Pyelography was not considered advisable in view of the low renal function and since both renal regions were mottled with shadows.

The patient left the hospital feeling well and again drove to Nebraska in his car. To my surprise he again appeared in April, 1923, stating that he had enjoyed fairly good health except for the repeated passage of bladder stones. Some time in the spring of 1922 he had consulted Dr. E. G. Davis of Omaha who had removed several stones by lithotrite. At this time he had only 90 to 100 cc. of residual urine but x-rays showed three large vesical calculi which were causing him considerable discomfort. I made two attempts to crush these stones but they were very large and soft and the procedure was unsuccessful. He insisted on relief so I removed these stones suprapubically, under local anesthesia,

closing the bladder tightly and leaving in a urethral catheter. In spite of the extreme bladder infection the wound healed promptly by first intention and he left the hospital in three weeks.

FIG. 4

In November, 1923, he again consulted me saying that he felt "better than ever" except for the pain of passing an occasional small stone from the bladder. At this time his blood urea nitrogen was 102 mgm. and the non-protein nitrogen 187 mgm. The residual urine measured from 60

to 90 cc., but there were no calculi in the bladder although the urine was ropy and very offensive. In June, 1924, a postal card announced he was "about the same."

There is no further record except that of his death which occurred November 30, 1925 (five years and five months after injury).

The interesting features of this history may be summarized:

1. The advisability (?) of instituting catheterization of the bladder after paralytic incontinence has developed.

2. The rapid formation of renal and vesical calculi subsequent to injury, the recumbent position and urinary infection. The large number of small stones found by x-ray four weeks after injury and three weeks after the onset of the urinary infection in the total absence of any prior history suggesting their presence would indicate that they had formed in this short period.

3. The fact that an individual could continue active in daily life, getting about on crutches, driving a car, etc., for five years with a constant urea nitrogen retention of over 90 mgm. per 100 cc. of blood and with an inappreciable output of dye in the urine.

4. The gradual diminution in bladder residual from 900 to 60 cc. during the period of two years after operation. The splendid functional result following laminectomy is notable and increases our desire to avoid urinary infection and its sequelae in these cases which survive the immediate injury and achieve an otherwise gradual return of function.

DISCUSSION

Dr. William F. Braasch (Rochester, Minn.): Dr. Graves deserves much credit for continuing his investigation of the physiology of the lower ureter and bladder, and I sincerely hope that he will continue this work, which promises so much. The differentiation he makes in the terminology of "reflux" and "regurgitation" is of considerable interest. It certainly would be desirable to have the two terms standardized. However, the suggestion he made seems to me to have one fallacy and that is that we can not always determine on clinical examination whether the patency of the ureterovesical valve is pathologic or physiologic. That being the case, I fail to see how the differentiation he made in terminology can always be followed in practical application.

A feature of this question which has interested me is the cause of potency of the ureteral orifice occurring with chronic inflammation of the ureter and bladder. This condition was well illustrated this morning by the urograms which Dr. Patch showed occurring with gangrenous cystitis. I have always believed that dilatation of the ureteral orifice permitting regurgitation was dependent upon changes in the ureteral wall subsequent to infection. Such regurgitation occurring with unilateral renal tuberculosis may cause considerable difficulty in localizing the renal lesion. Where the guinea pig inoculations from the supposedly well kidney are positive, it may be difficult to determine whether active tuberculosis exists in that kidney or whether regurgitation of tuberculosis bacilli has taken place from the bladder. The only proof that we have of regurgitation is that five or ten years later the patient is still well, and the remaining kidney is apparently normal.

It might be assumed that the guinea pig inoculation from the supposedly well kidney comes from a limited area in the bladder which remains tuberculous.

This is only one of the many problems which we have attending regurgitation, and it is one of the most interesting problems we have.

Dr. Francis R. Hagner (Washington): I want to congratulate Dr. O'Conor on this paper, but I believe that if this man had not been catheterized, he would not have had all these stones. I believe it is our duty to impress upon our men not to catheterize patients who have had spinal injury. We have been handling our cases without catheterization. One is five, one is six, and one is four years. They still have paraplegia following the injury and all those cases have never been catheterized. Many men pass a catheter in them if they have retention of urine for twenty-four hours. They all get infected. Sometimes cases do have infections even though they have not been catheterized but all become infected by the use of a catheter. These patients will sometimes go for forty-eight hours but they will all begin to overflow; they certainly will live longer, I believe than if we catheterize them.

Dr. Nathaniel G. Alcock (Iowa City): Speaking of Dr. O'Conor's paper, we do exactly the opposite of what Dr. Hagner recommends. It has been our experience that the vast majority of cases of bladder paralysis from spinal injury or neurological disease have been catheterized before they reach our care and they already have a urinary infection. The suprapubic drain relieves the infection; prevents further infection and its consequent damage to the kidney and its function; and, furthermore, keeping the patient dry and comfortable makes the care much less disagreeable, and removes one of the biggest factors in causing bed sores. The absence of these complications in cases so treated has so impressed both our general surgeons and neurologists that they are requesting this operation as a routine.

Cases of bladder paralysis usually die from one of three causes; pneumonia, renal infection and insufficiency, and sepsis from bed sores. We feel that the drainage eliminates to a very large extent the last two causes of death.

We feel that the operation is especially indicated in those cases of neurological disease where there is reason to believe that in time bladder function may be restored. I refer particularly to cases of encephalitis where the bladder paralysis may lapse for six months or more and then return. I have seen bladder drainage in such cases prevent infection and preserve the kidney function to such an extent that when the bladder function returned the patient went along with a pair of normal kidneys which I do not think he would have had if the gap had not been bridged over by this method of treatment. Furthermore, I am sure that in some of these cases the urinary infections and kidney damage would have caused the patient's death before his bladder function returned.

Dr. WILLIAM W. TOWNSEND (Burlington, Vt.): In the late war, the surgeons found that with injuries to the back or the spinal cord, the resulting distention of the bladder was better let alone to dribble than to catheterize.

Dr. ARTHUR L. CHUTE (Boston): It seems to me that we have been considering two things in the discussion, cases of traumatic injury to the cord, and cases of inflammatory disease of the cord. In the traumatic injuries to the cord I think it is probably better to develop, if possible, the automatic bladder but in cases of acute disease, as in acute myelitis, it seems to me probably desirable to do a cystostomy to relieve the backpressure, because there is a very considerable tendency for these people to improve as the inflammatory process quiets down.

In a case of acute myelitis seen some years ago with Dr. Walton, one of our leading neurologists, I drained a young woman's bladder by means of suprapubic incision. Dr. Walton's experience had been that a very large proportion of these people, if they did not die of the infectious part of the disease, died of the pyelonephritis which supervened. This patient made a rather slow convalescence, but she got back entirely her ability to empty her bladder. Since then she has married and has gone through two pregnancies. I believe that in this instance at least the cystostomy seems to have acted well.

Dr. WILLIAM C. QUINBY (Boston): I must take issue with Dr. Alcock in regard to the majority of cases following spinal injury. If one takes pains, in a certain proportion of them—what that exact proportion is I am not prepared to state—one succeeds in establishing the so-called automatic bladder; and if the bladder has not been infected by catheterization or not been put out of commission by a suprapubic opening, one then gets the individual patient so trained that he can automatically empty the bladder as a result of some sensory stimulus—it may be by pinching the skin of the abdomen; in one instance that I remember of a boy, it was pressing rather deeply on the outer side of either thigh. It is a sensory stimulus which causes the chronically overdistended bladder to contract and empty itself, and if one will search carefully over the skin surface of such individuals every once in a while one is able to establish such a condition of automatism, and that once established, the patient is no longer inevitably wet, and so far as the urinary factor is concerned, is not subjected to that source of bed sore.

These bladders may also often be emptied by manual expression above the pubes, at stated intervals of time.

Dr. GEORGE G. SMITH (Boston): Shortly after the war, Colonel Beasley had an article in the Journal of the American Medical Association, in which he advocated emptying these bladders by Credéing them. I remember one patient at Massachusetts General with an injury to the spine in whom we were able to do this. It was a very easy thing to empty his bladder by Credéing the fundus, and I think that is a possibility which should be borne in mind.

Dr. GILBERT J. THOMAS (Minneapolis): I wish Dr. O'Conor would tell us whether he was able to palpate masses in either renal area. I am wondering if he did not have present in this instance, some congenital condition of both kidneys.

Dr. ROGER C. GRAVES (Boston) (closing): I have nothing to add except a word of agreement with Dr. Braasch that a

differentiation between the terms "regurgitation" and "reflux" is not particularly important in those cases in which the ureterovesical mechanism is intact. I do feel, however, that it is misleading to use the word "regurgitation" to describe a passive back-wash or reflux from the bladder, through ureteral orifices that have been rendered patulous and rigid by long-standing infection. Under such circumstances, there is no question involved; the bladder and kidney pelvis are in open communication. Regurgitation, on the other hand, denotes an active phenomenon in which the contracting bladder, obstructed at the normal outlet, forcibly expels some of its contents backwards into the ureter in spite of intact ureterovesical relationships.

Dr. VINCENT J. O'CONOR (Chicago) (closing): Several years ago, Dr. Hagner demonstrated that dark silver solution placed in the bladder was "regurgitated" into the renal pelvis and flowed spontaneously from the tip of the ureteral catheter. He reported two such cases.

In attempting to get a rapid estimation of pelvic capacity, after the introduction of the ureteral catheter, I have been in the habit of using a suction syringe for the withdrawal of the urine. In doing this a number of times, I have frequently been surprised at being able to aspirate as much as three or four ounces of fluid and immediately concluded that I was dealing with a hydronephrosis. However, when I subsequently obtained a normal dye test and pyelogram, I was puzzled at the finding. It then occurred to me that I might be drawing fluid from the incompletely emptied bladder up along the catheter and down from the pelvis end. In checking this I found that when the bladder was completely emptied this excess of suction-removed fluid never occurred. I then tried coloring the bladder fluid with mercurochrome, after the ureter had been catheterized and in some fifteen cases succeeded in drawing off a considerable amount of stained fluid by suction in the catheter. The patients so observed had practically normal bladders and were not cases of vesical neck obstruction or chronically infected ureters or pelves. I then took some of these patients to see if I could knock

out the bladder musculature by giving the patients morphine and scopolamine hypodermically. When the same patients were absolutely relaxed and asleep I could not obtain an excess of fluid from the catheter by suction. My conclusion was that while the catheter was splinting the ureter, enough intravesical pressure was produced by the patient to allow a regurgitation of fluid upward when the negative pressure in the pelvis was produced by suction on the ureteral catheter.

I have felt that this observation might be important in obtaining urine for culture or smears from the kidney.

I have seen ten fractured spine cases in the last seven years in doing consultation work with railroad surgeons. It is difficult to suggest any standard method of caring for the bladder in these cases. There is such a diversity of opinion among the various urologists and industrial surgeons on whether suprapubic cystotomy, transurethral or expectant treatment should be carried out. I have followed nine of these patients with fractured spine and paralytic bladder with retention. I was forced to perform suprapubic drainage twice. One patient died three weeks later; one is alive today in fair general health, two years since the operation, with a marked pyelocystitis. Repeated pelvic lavage in these cases, as in the long standing tabetics, gives only temporary improvement. Two patients who were not catheterized, died within a week although both developed a certain amount of paradoxical incontinence. Two others who were never catheterized are very well and have no urinary infection. We try in these cases to stimulate a mass reflex by putting electric pads on their thighs, warm water douches of pelvis and scrotal region and by intermittent bladder compression.

The urological problem in connection with these patients is not merely trying to save the patient's life following the accident, but in addition to attempt to adopt a procedure which will result in a minimum amount of urinary pathology after the patient has survived the emergency.

Dr. Francis R. Hagner (Washington): I have watched these cases of ureteral regurgitation for many years and there is one

element of mistake that might be made. In the preparation of x-ray ureteral catheter, if they are baked a little too long, they will often be filled with minute openings and if you put any force on them, it is very easy to draw the colored fluid from the bladder. I thought that possibly might be an element in these cases.

SECOND DAY, MAY 10, 1927

SOLITARY CYST AND PAPILLARY CYSTADENOMA OCCURRING SIMULTANEOUSLY IN ONE KIDNEY

J. A. C. COLSTON

I feel very embarrassed about the title of this paper because I have to confess that on further study of the sections we had to modify the diagnosis; that is, the supposed area of tuberculosis in this kidney on further microscopic study proved to be an entirely different thing, but still I feel that the case is of sufficient interest to justify reporting on account of the rarity of solitary cyst and especially in combination with another condition.

The coexistence of two distinct disease processes in the same kidney is quite rare, although numerous instances are to be found in the literature. The occurrence of stone in association with tuberculosis is fairly common and some instances of stone with tumor have also been noted. Solitary cyst in itself is of great rarity and until the advent of this particular specimen to the pathological laboratory, no example of this disease had been seen at the Brady Urological Institute. When a study of the kidney showed that the unusual combination of solitary cyst and papillary cystadenoma were present as distinct entities the case was considered of sufficient interest to warrant a report. It is hardly necessary to state that the presence of the cyst was not suspected and that the nephrectomy was done under the impression that a malignant kidney tumor alone was present.

G. W. R., aged fifty-eight, was seen on March 15, 1926, complaining of profuse hematuria. The family history was unimportant. He had always enjoyed good health and his only serious illness was a severe infection of the left knee resulting from the bite of a boar which necessitated amputation of his thigh at the junction of the upper and middle thirds.

The patient first noticed blood in the urine three months previously. The blood persisted for several days, the urine then clearing. There were no other symptoms at this time except for slight frequency which had been present for some years. He again noticed blood about a month later and since this time he had passed blood intermittently, sometimes in the form of elongated or flaky clots, at other times definite fresh blood. The bleeding was never terminal. Recently there had been some straining at the end of urination and the frequency had become more pronounced.

On physical examination the patient was quite obese, but no essential abnormalities were made out with the exception of the amputation of the left thigh.

The abdomen was thick and pendulous and neither kidney could be felt. No masses or tenderness were present. The external genitalia were normal and on rectal examination the prostate was of normal size and everywhere smooth and elastic.

The urine was bloody, contained albumen and on microscopic examination red cells and a few white cells were present, but no organisms were seen.

On cystoscopic examination there was no intravesical hypertrophy of the prostate. The trigone was considerably hypertrophied, but the ureteral orifices were normal. From the right orifice blood stained urine could be seen coming in characteristic spurts. The bladder mucosa was everywhere normal except for considerable trabeculation. Ureteral catheters entered each orifice and easily ascended to the kidneys without meeting any obstruction.

The specimen from the right kidney was bloody and microscopically showed red cells, a few pus cells and epithelial cells, but no organisms. The specimen from the left kidney was clear and on microscopic examination only a few epithelial cells and an occasional leucocyte were seen. The function of the right kidney, measured by the urea estimation test, was considerably lower than that of the left.

A right pyelogram was done and the plate showed a characteristic filling defect (fig. 2) of the upper portion of the pelvis and of the upper calyx. A diagnosis of tumor of the right kidney was made and nephrectomy advised.

On April 7, 1926, the kidney was removed through a wide extraperitoneal incision which was carried out to the border of the rectus muscle. A large cyst was encountered at the lower pole which did not, however, complicate the operative procedure. The upper pole of the kidney was

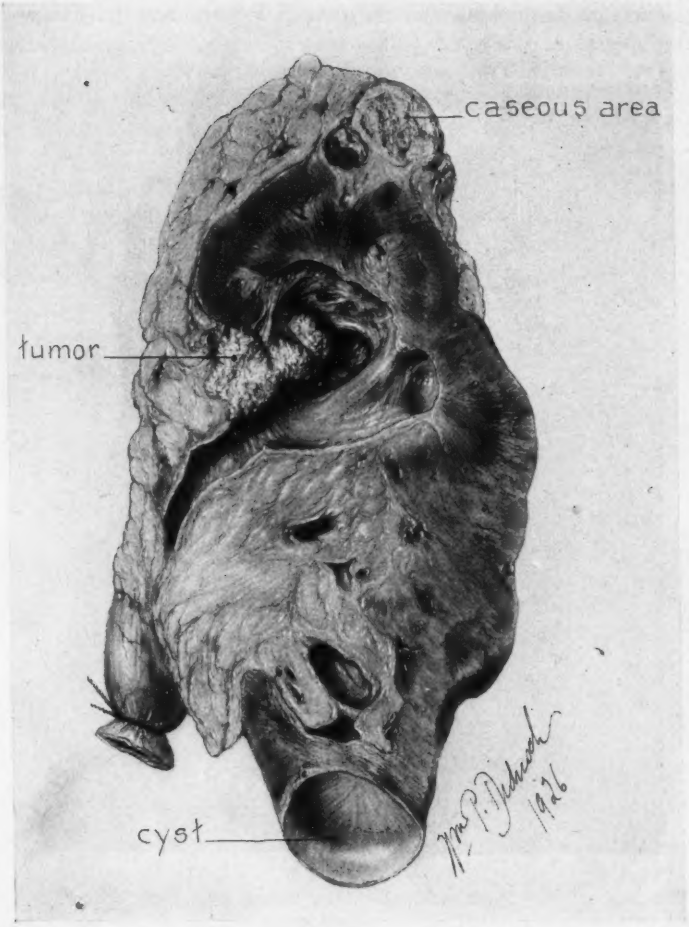

FIG. 1

densely adherent and a firm irregular structure was encountered here which was thought to be the adrenal. It was removed with the kidney without great difficulty.

The postoperative course was uneventful except for some superficial infection of the incision and the patient left the hospital five weeks after operation.

FIG. 2

The patient was seen again nine months after operation at which time the incision was firmly healed and there were no evidences of recurrence or metastasis. However, a few weeks later he began to lose weight and strength and evidence of pulmonary involvement became apparent. He died about a year after operation evidently from pulmonary and general metastasis although no autopsy was obtained.

Pathological report: The specimen consists of the right kidney with a portion of the ureter. A layer of perirenal fat surrounds the kidney but does not obscure a large thin walled cyst which is situated at the lower pole. The capsule splits readily and the surface of the kidney is smooth and normal. On section the kidney presents a most interesting appearance (fig. 1). At the upper pole beneath the capsule there

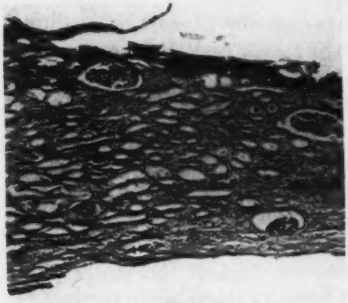

FIG. 3

FIG. 4

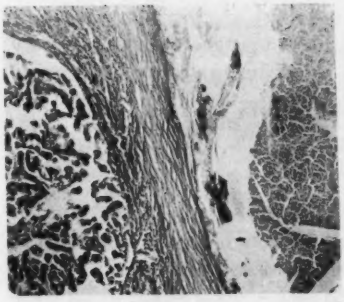

FIG. 5

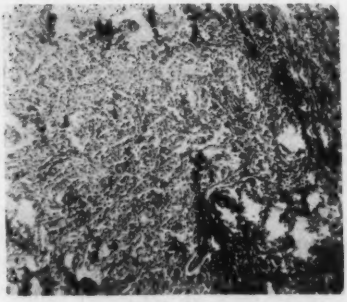

FIG. 6

is a firm whitish area which looks like caseation. Near the center of this area is a brownish patch which is somewhat suggestive of adrenal tissue. The kidney tissue about this pseudocaseous area is fairly normal in appearance and the area seems to be definitely circumscribed. The cortex is normal in appearance but the pyramids have largely been replaced by fat. A few small cysts were seen, the largest, however, measuring only a few millimeters in diameter. At the lower pole there

is, beneath the capsule, a thin walled cyst containing clear yellow fluid and measuring about 5 cm. in diameter. The surface of the cyst wall is smooth and there are no pronounced adhesions to it.

In the upper portion of the pelvis is a tumor mass which extends up into the upper calyx and invades the tissue of the kidney. This tumor is soft, yellow in appearance and the more superficial portions in the pelvis are necrotic. The tumor extends into the kidney tissue for only a short distance and in no place approaches the capsule. No direct connections can be made out between the tumor and the peculiar area described in the upper pole.

Figure 3. Section of a cyst wall and compressed kidney tissue. Cyst wall consists of fibrous tissue with a definite layer of endothelial cells. The kidney tissue shows dilated tubules, compressed glomeruli, with many hyalinized glomeruli and considerable scar tissue between the tubules with here and there an area of round cell infiltration. No tumor tissue is seen in this section.

Figure 4. Taken from the pseudocaseous area at the upper pole, shows this area to be a cyst lined with fibrous tissue with vestiges of the endothelial lining. The cyst cavity is filled with hyaline material. The tissue surrounding the cyst wall consists of typical papillary cystadenoma which has invaded the tissue in every direction. In some places the typical architecture of papillary cyst adenoma can be easily made out, and in some others columns of malignant cells are invading the tissue lawlessly in every direction. There is considerable round cell infiltration, in some places occurring in agglomerations of round cells. Only a few traces of normal tissue can be seen, altered tubules and glomeruli with scar tissue.

Figure 5. Area of papillary cystadenoma showing the typical architecture surrounded by scar tissue, through which columns of malignant cells, which have lost all architecture, are infiltrated. In the neighborhood of the larger tumor can be seen several small cysts with early papillary cyst adenoma projecting into their lumen.

CYSTADENOMA PSEUDO-PAPILLIFERUM MALIGNUM OF THE KIDNEY WITH METASTASES IN THE TONGUE

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The malignant atypical epithelial tumors of the kidney furnish a most interesting and, at the same time, still unsatisfactory chapter in special oncology. In no other organ—at least none of the major organic entities—exist today more confusion and lack of certain evidence as regards nomenclature, classification, derivation, etc. If we look for an explanation of the confusion surrounding this whole question, it is found principally in two factors; first, in the quite unique, highly specialized, epithelial character of the mesoblastic tissues which compose the organ; and secondly, in the complicated embryological metamorphosis which it undergoes. These factors in a way distinguish the malignant growths of the kidney from the typical carcinomata of ecto- or endodermal derivation, and no doubt are instrumental in so modifying their histogenesis and manner of growth as to take them out of the common class of other cancers.

The reader is referred to the writings of Ewing, and Lubarsch, and a recent article by Oberzimmer, for a complete review of the history and present status of our knowledge on this subject. He will be convinced at once, by the confusion in nomenclature, —to say nothing of the uncertainty of derivation, classification, etc.,—that the whole subject is in need of re-investigation and revision. This can best be accomplished by a more detailed and thorough study of cases as they present themselves. It is as a step in this direction that the following case is added to the literature. Besides several unique features, it presents certain characteristics as regards histogenesis and pathogenesis which are of considerable importance.

Clinical History

C. S. Male sixty-five years of age. Admitted January, 1927.

Complaints. Swelling of the abdomen of four years' duration. Fullness in the epigastrium after meals and occasionally vomiting. Some weakness and shortness of breath. Two months ago he noticed an ulceration on the right side of the tongue, which was painless.

Personal history. Born in Canada. Grocer by trade. Measles and mumps as a child—with left orchitis and later atrophy. Tuberculous arthritis of the right knee at eleven years of age, which became arrested after two years' treatment. It later became active and the leg was amputated twenty years ago. When about fifteen years of age had typical renal colic and passed several small calculi. He had no subsequent attacks. He denied all venereal disease and has used alcohol only very occasionally.

Family history. Mother died at age of sixty-seven of cancer. Father died at age of thirty-five of tuberculous enteritis, as did also one brother. His wife is alive and well. There have been no children, and no miscarriages.

History of present illness. About four years ago patient began to notice a gradual enlargement of his abdomen. This was especially marked on the right side. He paid no attention to this and it was not until some two years later that he began to suffer from a sensation of fulness in the epigastrium after meals; occasionally he was troubled with vomiting about fifteen minutes after eating. This was not accompanied by any sensation of nausea. The enlargement of the abdomen was by this time quite marked, and the mass occupied the whole right side of the abdomen and even extended across the mid-line.

He had not been troubled with any urinary symptoms, no frequency, no dysuria nor hematuria.

He was examined by his family physician at this time who recommended him to come to the hospital for an investigation of the tumor, but he refused.

About two months ago he noticed a small ulcer at the side of his tongue which would not heal. He became worried about this and readily agreed to enter the hospital.

On admission he appeared to be well developed and well nourished. There was no apparent loss of weight, no jaundice or cachexia. The teeth were carious and very dirty and a ragged stump in the right lower jaw was in immediate proximity to the ulceration of the tongue. This

was a hard, indurated lump in the right side of the tongue about 1 inch from the tip. The surface overlying this lump was not ulcerated to any marked extent. There were several enlarged glands in the submaxillary region on that side.

The chest was emphysematous. Resonant throughout and with no adventitious sounds. The X-ray of the chest showed the heart and aorta and diaphragm normal. There were no evidences of metastases in the lung.

The pulse was regular, 90 per minute. The vessel wall was slightly palpable. The heart was within normal limits, no thrill present. Sounds were well heard though there was a soft systolic murmur at the apex transmitted to the axilla.

Blood pressure 155/120.

The abdomen was distended by a mass which occupied the whole right side of the abdomen from the costal margin to the iliac crest, filling the right loin and extending slightly across the mid-line. This was firm, not tender, and its edges were rounded. The liver could not be differentiated from the mass. There was a dull note on percussion over the whole mass which moved slightly with respiration.

The right kidney could not be made out; the left was not palpable. There was no tenderness or distension of the bladder.

Penis normal—urethra easily admitted F. 16 soft rubber catheter—no residual urine obtained.

Scrotum, atrophied, soft left testicle—right normal.

The prostate was normal.

Urine was clear, amber, acid, 1018, no albumen, no sugar. Microscopically: a few white blood cells and few crystals.

The phenolphthalein test gave *55 per cent* in two hours.

Blood Wassermann was *negative*.

The blood urea was 0.44 gm. per liter of blood.

The blood urea nitrogen, 20.72 mgm. per 10 cc. of blood.

Creatinin 1.31 mgm. per 10 cc. of blood.

The blood count was: Red Blood Cells 4,800,000; White Blood Cells 8,000; Hemoglobin, 60 per cent.

An operation for the excision of the tumor of the tongue was performed.

The submaxillary lymph glands were dissected out, down to the bifurcation of the carotid, and found to contain one or two small, hard glands. Resection of the anterior portion of the right side of the tongue was done, about $\frac{3}{4}$ of an inch wide of the growth. In the floor of the

mouth, however, there was found what appeared to be an enlarged lymph gland, suggesting more tumor cells. This was also removed.

Following recovery from this operation, he was transferred to Urology for investigation of the tumor mass in the abdomen:

Cystoscopy showed the bladder mucosa to be normal; no tumor or foreign body seen.

Both ureteral orifices were normal and easily catheterized to the renal pelvis. Specimens for examination and culture were obtained from both sides.

	RIGHT	LEFT
Macroscopically	Clear amber	Hazy amber
Volume	¾ cc.	1 cc.
Urea	0.008	0.01
Microscopically	Occasional red blood cell epithelium	Red blood cells ++
Culture	No growth	No growth

X-rays with the ureteral catheters in place show the left catheter in normal position. The right catheter is pushed over to the left beyond the mid-line, and is closely associated with that of the left.

Pyelogram with 6 cc. 12 per cent sodium iodide in the right pelvis did not show any shadow of the iodide fluid.

An operation was then performed on the right kidney, and the report is as follows:

Operation. Curved right loin incision, which was extended anteriorly to almost the median line.

The muscles were incised, and a large, irregular, cystic mass was exposed extraperitoneally, which extended from underneath the diaphragm to well down into the bony pelvis, and medially almost to the left side.

By careful dissection this cystic mass, which had large vessels coursing over it, was freed and delivered.

In affecting the removal, the cyst was ruptured, and about 2 quarts of dirty, rusty fluid were evacuated.

The mass was found to be a large cyst of the lower pole of the right kidney. The upper pole still retained its shape and it was found that the vessels of the renal pedicle came off at this point. The vessels were clamped, cut and ligated. The ureter freed, clamped, severed with cautery and ligated. A rubber tube drain was inserted, and the wound closed.

The wound discharged for about ten days, then healed.

On discharge the urinalysis was:

Clear amber, 1018 acid, no albumen, no sugar, and microscopically an occasional white blood cell.

The phenolphthelein test was: First hour, 35 per cent; second hour, 25 per cent. Total 60 per cent.

X-rays of the long bones were negative for metastases, as were those of the lungs.

Description of surgical specimens

Although the kidney was removed after the metastases in the tongue, it is here described first because of its primary nature.

S. 289-27: Kidney and cyst. Specimen (fig. 1) consists of a rather small kidney, the capsule of which has been stripped, leaving a smooth surface. The pelvis is considerably dilated and the parenchyma narrowed, with partial loss of normal differentiation. The lower pole is replaced by a thick-walled cyst as large as a pumpkin, ellipsoidal in shape and 75 cm. in circumference. It is distinctly separated from the rest of the kidney by its thick capsule; this courses across the lower pole and beneath the mucus membrane of the pelvis, which, however, is free.

On section the cyst is found to contain 2750 cc. (2000 cc. removed at operation) of turbid, chocolate colored, rather sticky fluid. The fibrous cyst wall has a smooth outer surface and is approximately 1 cm. thick. There is no evidence of growth on its outer surface. Its inner surface, however, is covered with soft, necrotic, spongey, yellowish tissue. This varies in thickness up to about 5 cm. It has much the consistency and friability of placental tissue and is readily torn from the cyst wall. Many larger and smaller fragments lie free in the fluid contents.

Microscopic sections of the kidney at some distance from the tumor show relatively well preserved parenchyma, with here and there an obliterated tubule. Noticeable is an increase in irregular, hyaline, fibrous connective tissue between the tubules in the papillae of the medulla. This (fig. 2) has led to obliteration of some of the tubules. Calcareous degeneration has occurred in parts of this hyaline tissue.

As one approaches the capsule of the cyst in the lower pole, evidences of pressure upon the kidney parenchyma are seen. The tubules and glomeruli (fig. 3) are flattened, atrophic, and in part replaced by an ingrowth of fibrous connective tissue. This transformation becomes more and more marked as the cyst wall is reached. It consists of

closely packed bundles of fibrous tissue with only here and there evidence of a flattened atrophic tubule.

Sections taken from various areas of tumour tissue within the cyst present a most interesting series of pictures corresponding to the metamorphosis in the character of the neoplastic growth. Near the cyst wall, where it passes through the pole of the kidney, the growth (fig. 4)

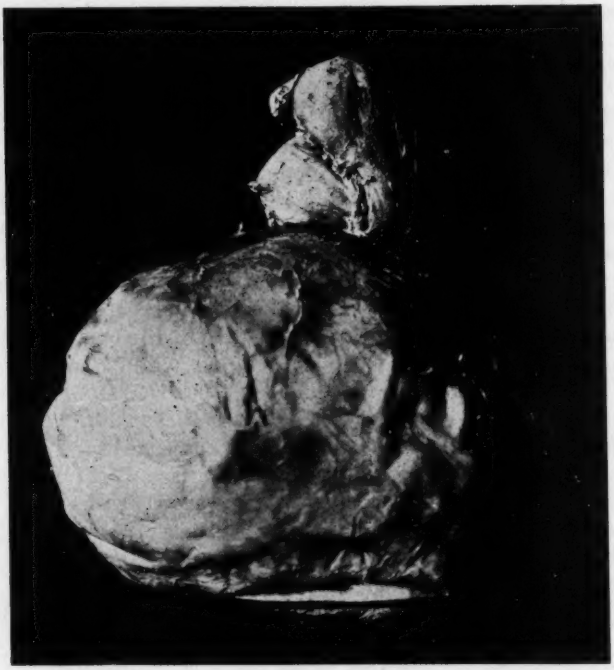

FIG. 1. GROSS SPECIMEN. KIDNEY WITH DILATED PELVIS AND CYST

consists of quite mature and regularly arranged, closely packed, tubular acini. They are supported by a fine, mature, fibrous connective tissue stroma carrying small blood channels. The tubules are quite round in the cross section, and resemble in size, shape and appearance the tubules (fig. 5) of the medulla of the kidney. The cells are cuboidal to columnar, with spherical nuclei which stain well, but not intensely. The

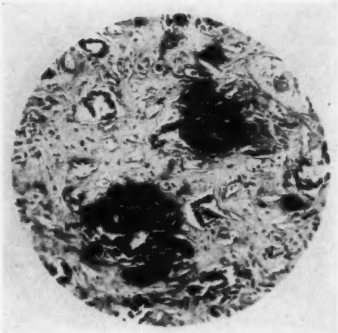

FIG. 2

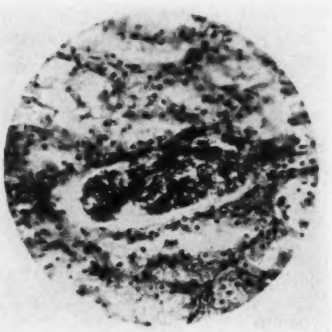

FIG. 3

FIG. 2. PHOTOMICROGRAPH, LOW POWER. MEDULLA OF KIDNEY SHOWING HYALINE FIBROUS TISSUE WITH CALCAREOUS DEGENERATION

FIG. 3. PHOTOMICROGRAPH, HIGH POWER. GLOMERULUS NEAR CYST COMPRESSED AND FLATTENED

FIG. 4

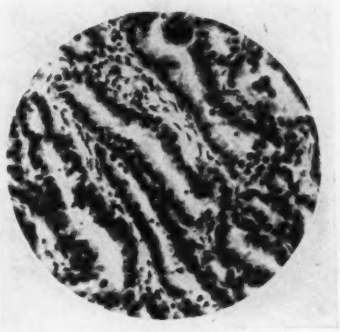

FIG. 5

FIG. 4. PHOTOMICROGRAPH, HIGH POWER. ADENOMATOUS AREA, SHOWING QUITE MATURE TUBULES IN CROSS SECTION

FIG. 5. PHOTOMICROGRAPH, HIGH POWER. ADENOMATOUS AREA, SHOWING TUBULES IN LONGITUDINAL SECTION

FIG. 6

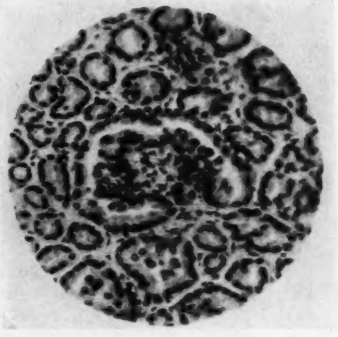

FIG. 7

FIG. 6. PHOTOMICROGRAPH, HIGH POWER. CYST-ADENOMATOUS AREA, SHOWING DILATED CYSTIC TUBULES

FIG. 7. PHOTOMICROGRAPH, HIGH POWER. TWISTED TUBULE, SIMULATING GLOMERULUS FORMATION

Some contain blood

FIG. 8

FIG. 9

FIG. 8. PHOTOMICROGRAPH, HIGH POWER. PSEUDOPAPILLIFEROUS PROJECTIONS INTO LUMEN OF CYSTIC TUBULES

FIG. 9. PHOTOMICROGRAPH, HIGH POWER. SHOWING METHOD OF FORMATION OF PSEUDOPAPILLAE BY ATROPHY AND NECROSIS OF CENTRAL PORTION OF ADJACENT ACINI

cytoplasm is quite abundant, especially in the columnar cells, and finely granular. The nuclei are arranged regularly at the base of the cells, which rest on a rather rudimentary basement membrane. The growth in this locality is quite regular in appearance, and would come under the designation "adenoma."

One soon observes, however, by examining other fields in the neighborhood, the first evidences of less fixed and restful arrangement. The

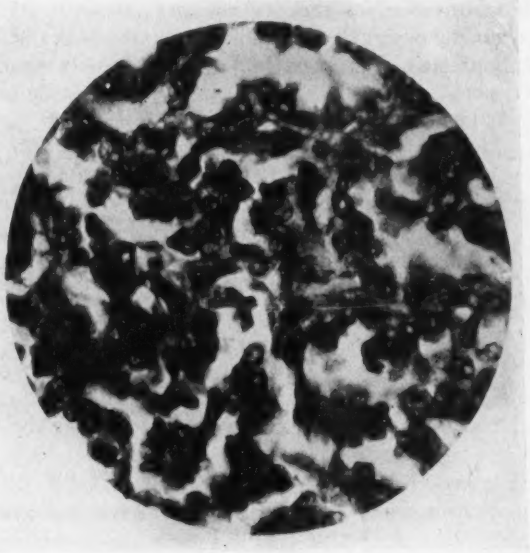

FIG. 10. PHOTOMICROGRAPH, HIGH POWER. AREA SHOWING MORE MALIGNANT IRREGULAR GROWTH

tubules become, not only larger in diameter, but irregular and tortuous in shape. Some are twisted on themselves, with invagination of the wall, that they suggest a rudimentary glomerular formation (fig. 6), but any capillary tuft is lacking. The cells have more cytoplasm and larger nuclei, which often lie away from the base of the cell. There is a suggestion of crowding of the cells within the acini. The tubules tend to dilate and become cystic, with occasional hemorrhagic extravasations into the lumen (fig. 7); and as this dilation becomes more marked, the picture of *cystadenoma* is produced.

Fields even farther removed from the kidney, under the cyst wall, show the next step in the transformation. This expresses itself in a definite change in the character and arrangement of the neoplastic cells. There cytoplasm is scanty, though what remains is always pink-staining and granular, never clear. The nuclei, on the other hand, are larger, more oval and vesicular, with more prominent nucleoli. The cells vary so much in size that no regular arrangement is possible, although they remain a single, not stratified, layer. The stroma is scanty and less mature, but a basement membrane is preserved.

Here occurs the formation of papilliferous projections (fig. 8) into the lumen of the dilated acini. Some of these are merely small invagina-

FIG. 11

FIG. 12

FIG. 11. PHOTOMICROGRAPH, LOW POWER. METASTATIC GROWTH INVADING EPITHELIUM OF TONGUE

FIG. 12. PHOTOMICROGRAPH, LOW POWER. METASTATIC GROWTH IN TONGUE

tions, apparently due to crowding of the cells, while others are definite papillae with stalk and overlying epithelium. Analysis of the formation of these projections, however, demonstrated that they are not true papilliferous growths, but rather portions of aborted and incomplete tubular walls, which have fused to form large acini with irregular walls. This is quite obvious (fig. 9) where such adjoining tubules have completely formed and the more central, inner portion of the fused wall has undergone atrophy and necrosis. The remaining well preserved end portions of such neighboring tubules then fuse into papillae, while the portions farthest removed from the blood supply show necrotic dissolution changes which eventually result in their loss. In these necrotic

parts, affected cells become smaller, paler-staining, with pyknotic, dark-staining nuclei; they then break up into necrotic detritus. An arrangement simulating papillary growth may also be produced by folding over of tubules. The lumina of the acini are for the most part clear. A few contain blood, cell detritus or cellular exudate, but there is no appreciable evidence of a secretory activity on the part of the lining cells. Such a neoplastic structure would be termed *cystadenoma papilliferum*, or better—*cystadenoma pseudo-papilliferum*.

Finally, there occur occasional areas in which this arrangement breaks down. The lining cells are more irregular in size and shape and embryonic in general appearance. They tend to pile up within the acini and break through the basement membrane, so that the whole character and arrangement of the growth (fig. 10) take on a malignant character or degeneration,—*cystadenoma pseudo-papilliferum malignum*.

Sections stained by Sudan III and Scarlet Red show fine fatty granules in some of the better preserved neoplastic cells. Only as they become degenerated and necrotic, however, is this a conspicuous feature.

S. 167–27: Tissue from the mouth. Specimen consists of: (1) A portion of the tongue 3.5 cm. by 215 cm. On the surface is a whitish, firm, ulcerated area 1.5 cm. in diameter. (2) An irregular mass of moderately firm tissue as large as a golfball, in which several gland-like structures can be differentiated.

Microscopic sections of the ulcerated area in the tongue (fig. 11) show involvement of the corium by a metastatic growth simulating in every respect the more atypical portions of the kidney tumour. It has invaded the squamous epithelial surface, causing ulceration. Sections of the deeper glandular like masses (fig. 12) lying in the musculature present identical pictures.

DISCUSSION

There are several interesting and relatively unique features about this case which should be discussed here, particularly in their relation to the question of neoplasms of the kidney in general.

As regards the metastases in the tongue, the case is a curiosity. Kaufmann points out the extreme rarity of metastatic growths in this organ, when hematogenous and borne from a distant primary focus. It is not surprising, therefore, that the ulceration on the tongue was considered clinically a primary carcinoma, particularly in the presence of a jagged, irritating

tooth. Its nature was revealed only in microscopic examination, and its kidney derivation suggested by the type of growth. Very striking is the complete preservation of the papilliferous cystic character in the metastases. We are unable to find any evidence of other metastases, although very possibly they exist.

Turning to the primary growth: its general gross appearance is first of all noteworthy. It did not have the usual structure of papilliferous cystadenoma of the kidney, but was well contained within a very large, thick-walled cyst. On opening the latter, the chocolate colored fluid contents and the yellow color of the spongy, neoplastic, necrotic tissue combined to present a gross picture much more suggestive of hypernephroma. In fact a true hypernephroma of very similar gross appearance was recently removed in this hospital.

The microscopic sections from various portions of the growth present a most extraordinary and complete series of the various stages of neoplastic metamorphosis. Such changes, contained within the boundaries of a single cyst wall, are very rarely encountered. The various steps of adenoma, cystadenoma, cystadenoma papilliferum, and, finally, quite atypical hyperplasia, are here so well defined as to be indisputable. It seems that this neoplastic process, extending apparently over a period of several years, quite gradually gained speed and as gradually lost its characteristics of higher differentiation; and that its malignant, cancerous terminization had its original source in a typical adenomatous structure. It therefore supports the theory, which has been prevalent for some time, that the malignant growths of the kidney may arise from benign adenomata. Moreover, the absence of any pathological changes in the kidney suggestive of a productive nephritis rules out the possibility of this growth on the basis of regenerative epithelial proliferations in a contracted kidney. There are, however, quite extensive calcareous deposits in fibrous scar tissue in the papillae of the medulla. These may quite possibly be old healed tuberculous lesions, although one would not be justified in coming to any positive conclusions from the sections. With a distinct history of tuberculosis in adolescence this appears more probable. That the neoplastic process

arose on the basis of disturbed tissue relations as a result of these calcareous changes is, of course, so hypothetical that it could be suggested merely as a possibility, particularly when one recalls the not uncommon occurrence of nephrolithiasis and carcinoma of the kidney in individuals of advanced age.

Another interesting feature of this case is the papilliferous character. Borst has pointed out that one must distinguish between true and false, or pseudo, papilliferous projections into the lumina of cystic growths. Moreover, he states that so many so-called true papilliferous tumors, particularly of the kidney, on careful examination, show the papillae to be merely portions or irregular and aborted attempts at gland tubule formation, or well formed glands in which the portion farthest removed from the blood supply has undergone atrophic necrosis and eventually disintegration. This phenomenon is very beautifully shown in the sections from the more cystic portions of this growth. We are inclined to believe with him that probably the majority of papilliferous cystadenomata of the kidney are of this really false type, although once the process is completed it is difficult to distinguish between them.

In reviewing the literature we are unable to find any case which corresponds to the principal features of this one. The metastases in the tongue of such a growth, with ulceration and a clinical picture simulating primary carcinoma, makes the case, so far as we can determine, quite unique. Malignant transformation of papillary cystadenomata has been described by numerous writers. Frontz recently reported a case with apparent implantation in the operation wound. Kretschner and Moody in 1914 collected 11 cases, including their own; and Wohl more recently added 1. This small number, however, we believe, greatly over-emphasizes the rarity of this type of growth. Most of these cases, however, are apparently much more solid and diffuse in their manner of growth than this case. They lack the breaking down from central necrosis into a single large, thick-walled cyst lined by a comparatively thin inner layer of papilliferous cystadenomatous tissue. Moreover, it is extraordinary to have the transformation from benign adenoma to cancer growth so clearly and sharply defined.

In reviewing the literature on kidney tumors, much confusion arises from the lack of a well defined and universally accepted and recognized terminology. This appears due principally to two faults of our present system, which are unfortunately so deeply rooted in the literature that they give rise to false conceptions.

First, there is the sharp separation of the hypernephromata, as absolutely specific in derivation and type, which followed the acceptance of Grawitz' theory that certain tumors of the kidney are derived from adrenal rests. We now realize that many tumors have been here included which certainly are not of such derivation, and that such a clear-cut division of renal from suprarenal tumors does not exist. This has been emphasized by Lubarsch, who has introduced the term "hypernephroid" as noncommittal as to origin. It is discussed at length in a recent article by Oberzimmer, to which the reader is referred. As a matter of fact, the separation of hypernephromata is no longer considered as based on origin, but rather on characteristic features in cell type and manner of growth.

Secondly, and even less fully recognized, there exists too sharp a separation and classification of glandular tumors on the basis of papillomatous structure. As stated above, the distinction between false and true papillary formation has not received sufficient recognition, and there is no genuine reason for the sharp separation between papillary and non-papillary growths. Too great emphasis is placed in current classifications upon this secondary feature of manner of growth. Its conspicuousness has perhaps led to this over-emphasis. But the impossibility of such strict divisions is borne out by cases such as this, in which the growth shows both alveolar and papillomatous characters. It would appear to us that in future a classification of kidney tumors must keep the possible genetic relation of the various glandular types of kidney tumors in mind, and emphasize their possible modifications and transition in growth, instead of, as current at present, treating them as more or less independent categories.

Briefly some interesting features of this case are:

1. Malignant growth of the kidney with metastases in the tongue.
2. Gross appearance simulating hypernephroma.
3. Transformation from benign adenoma to malignant growth, both clinically and microscopically.

CONCLUSIONS

A case of cyst adenoma pseudo-papilliferum (malignum) of the kidney with metastases in the tongue is described. The case has several unique clinical and pathological features which permit certain observations on the origin and histogenesis of this type of growth and the classification of tumors of the kidney in general.

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PAPILLARY EPITHELIOMA OF THE RENAL PELVIS

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Papillary epithelioma of the renal pelvis is the least malignant of all malignant lesions of the kidney. Its true malignancy, however, in terms of the results of treatment, by virtue of its characteristic extension, is actually greater than that indicated by the extent of cellular differentiation.

Primary epithelioma of the renal pelvis occurs with relative infrequency as the parenchyma of the kidney is the usual site of tumor formation. Series of cases of miscellaneous renal tumors disclose an incidence of primary epithelioma of the renal pelvis of from 1 to 5 per cent. Scholl, in 1924, reported an incidence of thirteen primary epitheliomas of the renal pelvis in a series of 273 renal tumors. From January 1, 1910, to May 1, 1927, 318 malignant tumors were removed by nephrectomy at the Mayo Clinic, of which twenty-three were primary epitheliomas of the renal pelvis; this incidence of 7.2 per cent of all renal malignant tumors indicates a ratio of approximately 1 of the pelvis to 14 of the renal parenchyma. While these 23 primary epitheliomas of the renal pelvis were all of the squamous-cell type, 8 were sessile and 15 were distinctly papillary. It is the latter group of 15 cases of papillary epithelioma which I shall discuss here; 8 of these were reported in Scholl's series, 2 of which had been reported previously by Judd.

The microscopic characteristics of the cells of primary epithelioma of the renal pelvis readily present the difference between the sessile type of tumor and the papillary type so far as the pathologic diagnosis is concerned, and, while the tumors have the same genesis, they differ materially in degree of malignancy and manner of growth and extension.

Pathology in the past has had to do with diagnosis and, with the advent of the microscope, cellular characteristics have formed the basis for classification of tumors, supplanting classification by gross appearance. It has been a frequent clinical observation, in following the postoperative results of the treatment of malignant disease, that some patients live much longer than others, even though the lesions were of the same degree of development and were treated by the same methods of excision. The microscopic characteristics of cells and tissues were utilized only for the purpose of establishing diagnoses, and until recent years their probable relation to the degree of malignancy escaped attention. MacCarty, Powell, and others have shown that such microscopic manifestations as lymphocytic infiltration, fibrosis, hyalinization, and cellular differentiation exert a marked influence on the length of life after operation, and that the average postoperative life is longer when these factors are present singly or in combination. These observations suggest that such activities play a significant part in the natural defense mechanism against malignant disease, once it has developed.

Broders has shown that cellular activity exerts a marked influence on the progress, clinical manifestations and ultimate results of treatment of maligant disease. He has utilized cellular differentiation as a means of grading epitheliomas, classifying malignancy under four grades, each dependent on the proportion of differentiated to undifferentiated cells. In grade 1, the differentiated cells range from almost 100 to 75 per cent; in grade 2, from 75 to 50 per cent; in grade 3, from 50 to 25 per cent, and in grade 4, from 25 per cent to practically no differentiation. The clinical application of this method of grading has shown that the epitheliomas in grade 1 are indolent in growth, tend to remain localized lesions without an early tendency to metastasize, and possess little tendency to recur after removal, whereas those in grade 4 grow rapidly, extend locally, metastasize at an early period, and tend to recur after radical removal. That there are degrees of malignancy is not longer questionable and the degree of malignancy must be considered in prognosis.

Primary epitheliomas of the renal pelvis differ in their degree

of malignancy. The sessile epithelioma of the renal pelvis is highly malignant, while the papillary epithelioma is relatively benign. All of the 8 patients with sessile epithelioma of the renal pelvis seen at the Mayo Clinic since 1910 have died. Two died in hospital on the ninth and tenth days, respectively, after operation; 1 patient lived three and a half years and died from metas-

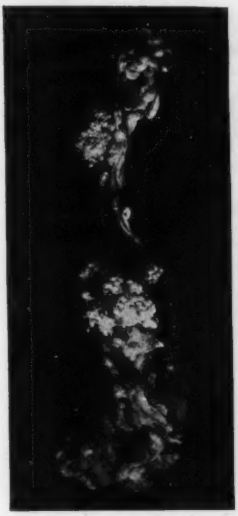

FIG. 1

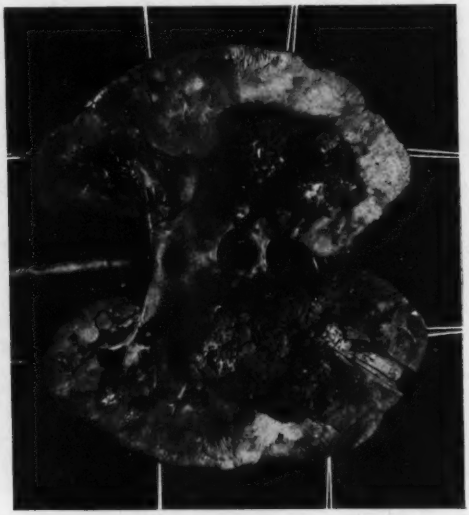

FIG. 2

FIG. 1. EXTENSIVE INVOLVEMENT OF THE URETER WITH PAPILLARY EPITHELIOMA SECONDARY TO THE PRIMARY LESION IN THE RENAL PELVIS

FIG. 2. EXTENSIVE INVOLVEMENT OF THE RENAL PELVIS AND CALICES WITH PAPILLARY EPITHELIOMA

tasis, and the remaining 5 lived less than six months after operation. The results in the cases of papillary epithelioma of the renal pelvis have been better; 6 patients are living and well, 3 less than a year later, and 3 for seven, five, and three years, respectively. Of the 9 who died, one lived seven and a half years, one four and a half years, one three and a half years, one two and a half years, and five less than one year, after operation.

Broders recently reëxamined the tissue in the 23 cases of primary epithelioma. Grades 3 and 4 malignancy predominate in the sessile epithelioma, there being 3 cases in each grade; 2 cases were in grade 2. The degree of malignancy is high for the group. On the other hand, grade 2 predominates in the cases of papillary epithelioma; 12 cases were in grade 2, 2 in grade 3, and 1 case in grade 4. In this group the grading is relatively low, and this is borne out by the ultimate results. In other words, the degree of malignancy tends to parallel the postoperative length of life.

FIG. 3. PRIMARY PAPILLARY EPITHELIOMA OF THE RENAL PELVIS LESS THAN 1 CM. IN DIAMETER, WITH EXTENSIVE INVOLVEMENT OF THE URETER AND BLADDER

These two types of primary squamous-cell epithelioma of the renal pelvis differ in manner of growth and extension. The sessile epithelioma progresses and extends by invasion into perirenal tissues, renal vein, and so forth, and metastasizes remotely, while the papillary type progresses not by invasion but by extension along the mucous membrane of the calices, ureter and bladder (fig. 1).

True papillary epithelioma may remain confined early in its development to the renal pelvis and involve the major portion of the renal pelvis and calices before extension down the ureter

occurs (fig. 2) or, as in one case (case 14), the primary lesion may remain small with early progression and extensive involvement of the ureter and bladder, occlusion of the ureter, and early hydronephrosis (figs. 3 and 4). In none of the 8 cases of sessile epithelioma of the renal pelvis was the bladder involved, nor was the ureter or bladder affected at any time previous to death. Of the group of 15 cases of papillary epithelioma of the renal pelvis the bladder around the ureteral orifice or immediately adjacent to it was involved in four, and in five others involvement of the

FIG. 4. EXTENSIVE INVOLVEMENT OF URETER AND BLADDER ABOUT THE URETERAL ORIFICE RESULTING IN EARLY HYDRONEPHROSIS

bladder was noted from nine to fourteen months after nephrectomy. From letters received, it may be assumed that the hematuria occurring during the latter months of life in two other cases was due to recurrence.

Broders, in reëxamining the tissue in these cases of papillary epithelioma of the renal pelvis, examined the primary tumor in the renal pelvis, and the secondary transplants in the ureter and bladder when they were removed, and found no difference in the degree of malignancy between the transplants and the primary lesion.

DIAGNOSIS

Hematuria is the most constant symptom. It occurred in all of the 15 cases in this series. The presence of a palpably enlarged kidney is usually dependent on the presence of hydronephrosis. A large renal tumor was palpable in 5 of the cases, and in each instance was due to hydronephrosis. The presence of a papillary tumor of the bladder, at or near the ureteral orifice, as seen on cystoscopic examination, should immediately give the clue to the diagnosis. Such a tumor was present in but 4 cases on primary cystoscopic examination; in a fifth case a small amount of papillary tissue projected from the ureteral orifice. In cases in which transplantation to the bladder has not occurred the diagnosis of renal tumor may usually be established from the pyelogram. Because of the irregularity of the pelvic outline in the pyelogram in four cases, Braasch and his associates suggested a diagnosis of papillary epithelioma in addition to that of renal tumor.

Foulds, in an analysis of 240 cases of carcinoma of the kidney occurring in adults, noted that it was most common in the sixth decade. Forty-one per cent occurred between the ages of fifty-one and sixty. The average age was fifty-two.

In this series the average age was fifty-one; the youngest patient was thirty-four, and the oldest sixty-five. Eleven patients were men and four were women.

TREATMENT AND RESULTS

The tendency of papillary epithelioma of the renal pelvis to progress by extension along the mucous membrane of the ureter, and subsequently into the bladder has long been recognized. However, unless the bladder is involved, the surgical procedures in the past have been limited usually to nephrectomy, often with partial ureterectomy and occasionally complete ureterectomy; the latter procedure has usually been carried out at a later date, when recurrence of hematuria indicates ureteral involvement. Four patients in the series were treated by simple nephrectomy. One of these, with a grade 3 papillary epithelioma, is living and well three years after operation. One patient with an epithelioma of

grade 2 malignancy died after four years with extensive recurrence in the bladder; 2 patients with epithelioma of grade 2 malignancy died at the end of five and six months, respectively. One patient with a grade 2 papillary epithelioma is living and well seven years after nephrectomy and partial ureterectomy. There were 8 cases in which complete nephro-ureterectomy was performed, the ureterectomy from two weeks to as late as twenty-one months after nephrectomy. In four of these its was necessary to perform simultaneous segmental resection of the bladder for vesical metastasis that had occurred since the nephrectomy. There were two hospital deaths in this series, one from pulmonary embolism on the eleventh day, and the other from pelvic peritonitis on the thirteenth day resulting from a necessary transperitoneal resection of the bladder. One patient of this group was living and free from recurrence at a recent examination, five and a half years after operation; another is living four months after operation. Three patients who died from recurrence lived two and a half, three and a half, and seven and a half years, respectively, following late ureterectomy and resection of the bladder for metastasis.

With the exception of the 1 patient living three years after nephrectomy for a grade 3 papillary epithelioma, and the 2 patients with tumors graded 3 and 4 who died in the hospital, all the patients in this series had tumors graded 2. The grade of malignancy being equal, it is obvious that ureterectomy in addition to nephrectomy, even though a number of months later, offers a better prognosis than nephrectomy does.

Judd, in 1924, recommended removing the ureter down to the wall of the bladder at the time of nephrectomy, or at a second-stage operation soon afterward, in all cases of papillary epithelioma of the renal pelvis. However, as the result of past experience with the high incidence of metastasis to the portion of the bladder immediately surrounding the ureteral orifice, or immediately adjacent to it, segmental resection of that portion of the bladder to include the intramural portion of the ureter and the adjacent area simultaneously with nephro-ureterectomy seems necessary to insure the best prognosis. The results seem to show that the interval between nephrectomy and subsequent ureterectomy is

an important factor in the prognosis, and is readily obviated by the one-stage complete operation of nephro-ureterectomy with segmental resection of the bladder.

I recently carried out this procedure in 2 cases in this series. The extraperitoneal operation is readily accomplished through the posterolateral approach described by W. J. Mayo a few years ago and the low median-line abdominal incision. If the diagnosis of

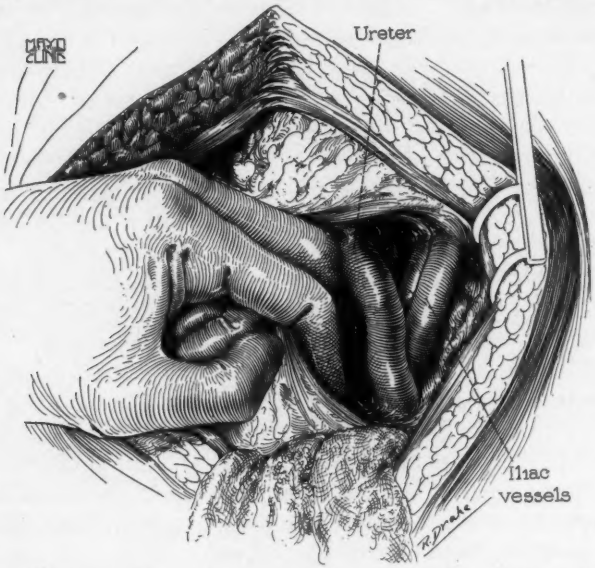

FIG. 5. EXTRAPERITONEAL EXPOSURE OF THE URETER IN ITS LOWER THIRD

papillary epithelioma of the renal pelvis has been accurately established by the presence of metastasis to the bladder it is desirable to proceed with exposure of the lower portion of the ureter and resection of the bladder before the kidney is removed. This facilitates the removal of the entire specimen intact. Through a low median-line incision extending from the pubes to the umbilicus extraperitoneal access to the lower two-thirds of the ureter and bladder is readily afforded (fig. 5). The ureter is entirely freed, down to the ureterovesical juncture, and the base of the

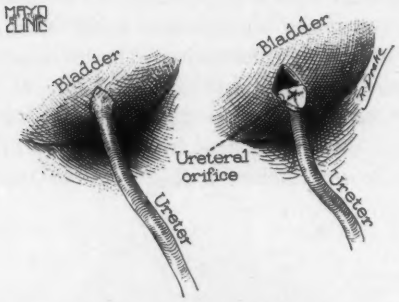

FIG. 6. METHOD OF COMPLETE URETERECTOMY INCLUDING INTRAMURAL PART OF THE URETER

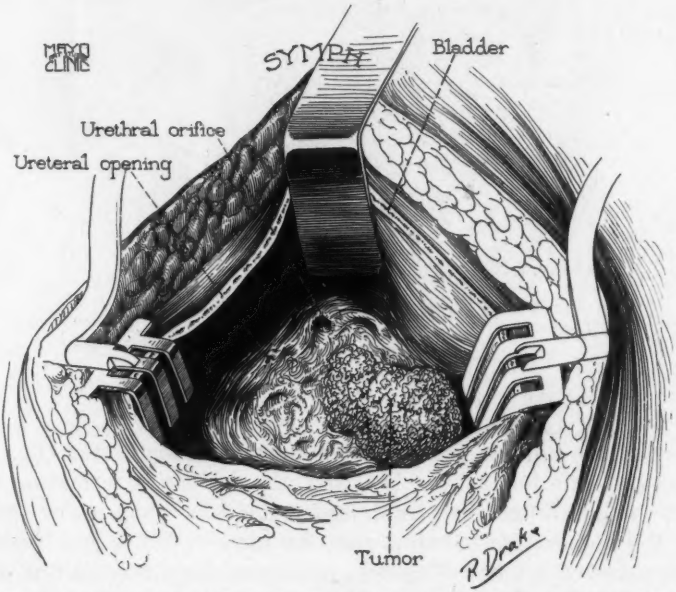

FIG. 7. INTRAVESICAL EXTENSION OF PAPILLARY EPITHELIOMA OF THE KIDNEY AND URETER

bladder is elevated to allow excision of the intramural portion of the ureter and an area of bladder wall immediately adjacent to it (fig. 6); in the event of metastasis to the bladder, this facilitates such wide segmental resection as to include at least 1 cm. of normal bladder wall around the growth (figs. 7, 8, and 9). The resected segment of bladder and lower portion of the ureter are wrapped in gauze and tucked high in the extraperitoneal space

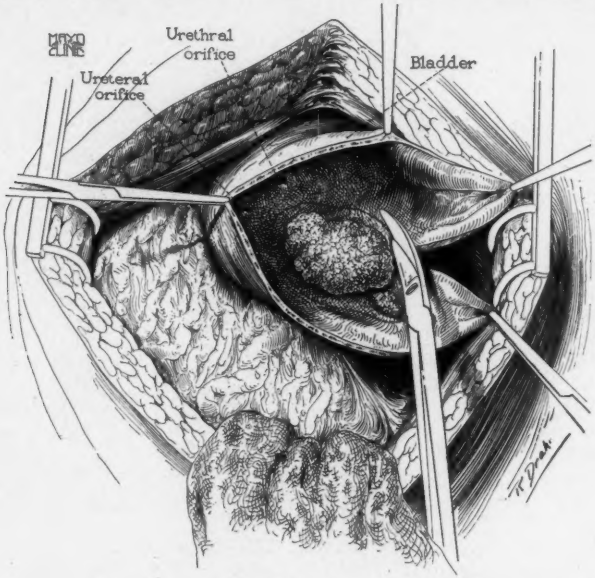

FIG. 8. SEGMENTAL RESECTION OF THE BLADDER

toward the kidney. After the bladder is reconstructed (fig. 10) and the anterior incision is closed, the patient is turned on the side, and through the posterolateral incision, which gives access to the upper third of the ureter, the kidney, ureter and bladder are removed intact. This was readily accomplished in one case (case 14) of the series.

In one case (case 15) a diagnosis of left renal tumor was made and papillary epithelioma of the pelvis was strongly suspected.

The diagnosis was established through exploration of the kidney which disclosed a dilated, doughy, purple pelvis, characteristic of papillary epithelioma. The vascular pedicle was ligated, the upper third of the ureter freed, and the kidney brought outside the wound, which was closed around the ureter. Through the

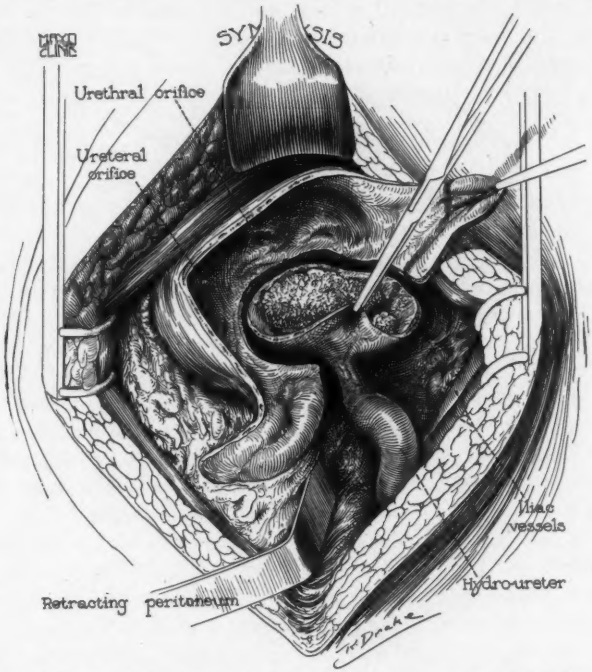

FIG. 9. EXCISED SEGMENT OF THE BLADDER INCLUDING TUMOR EXTIRPATED WITH THE URETER ATTACHED

anterior median-line incision resection of the bladder was accomplished and the ureter and segment of bladder pushed up into the extraperitoneal space toward the renal area and removed in one piece with the extirpated kidney through the posterolateral incision. There is no particular object in removing the specimen intact in the absence of involvement of the ureter or bladder;

however, division of an affected ureter favors transplantation to the perirenal and peri-ureteral tissues. However, whether the ureter is divided or not is probably of minor importance. The important factor is the elimination of the time interval between nephrectomy, and ureterectomy and resection of the bladder.

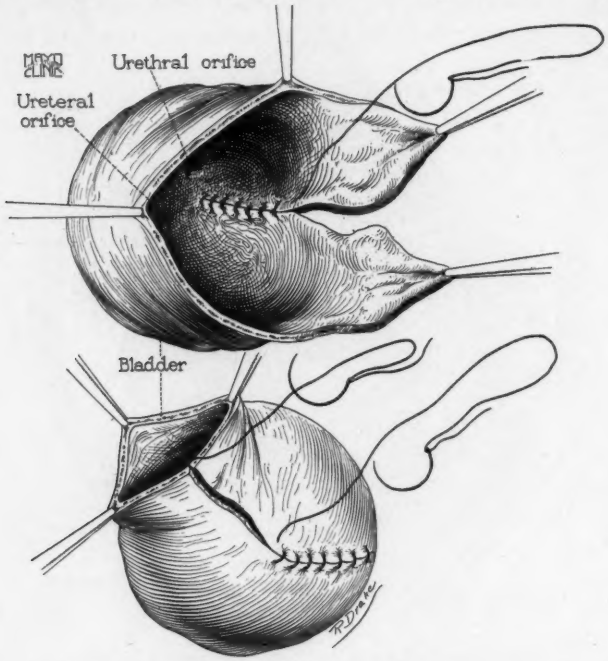

FIG. 10. METHOD OF TWO ROWS OF SUTURES IN RECONSTRUCTING THE BLADDER AFTER SEGMENTAL RESECTION

I would emphasize that as far as malignant tumors of the kidney are concerned papillary epithelioma of the renal pelvis is the least malignant. It tends to progress by extension along the mucous membrane of the pelvis, ureters and bladder. Even though the grade of malignancy remains the same as that of the primary lesion, the prognosis is materially altered when extension to the bladder has occurred. In order to forestall such metasta-

sis, segmental resection of the bladder should be performed simultaneously with complete nephro-ureterectomy.

REPORT OF MAYO CLINIC CASES

Case 1.[2] A man, aged forty-seven, came to the Clinic, February 21, 1910, on account of hematuria and pain in the area of the right kidney. A diagnosis of right pyonephrosis with stones was made, and nephrectomy was performed March 1. Stones and papillary epithelioma, grade 2, of the pelvis of the kidney were found. The patient lived only five months.

Case 2. A man, aged fifty-five, came to the Clinic, October 25, 1917, on account of hematuria of nine months' duration. Until recently there had been no other symptoms referable to the bladder. Cystoscopic examination disclosed that the left kidney did not function, and on November 17, the kidney and the upper 10 cm. of the ureter were removed. Section of the kidney showed extensive papillary epithelioma of the pelvis, grade 2.

The patient returned to the Clinic, December 5, 1918, having suffered from severe attacks of hematuria the preceding four months. Cystoscopic examination at this time disclosed a tumor of the bladder surrounding the left ureteral orifice. January 3, 1919, segmental resection of the bladder was performed and the remaining portion of the ureter removed. A papillary epithelioma, grade 2, about 2.5 cm. in diameter projected from the left meatus. Cystoscopic examination October 13, disclosed multiple papillomas at the base of the bladder, to which radium was applied. Increasing frequency of urination continued, and cystoscopic examination showed that the recurrent tumors had become much larger. March 24, 1920, the tumor was excised by cautery. Several subsequent attempts were made to cauterize the tumors but the patient died March 8, 1921, the immediate cause of death being marked right pyelonephritis. Necropsy did not disclose evidences of remote metastasis.

Case 3. A man, aged thirty-four, came to the Clinic, January 18, 1919, on account of hematuria for twenty months (almost constant for nine months), and slight pain in the area of the left kidney.

Cystoscopic examination revealed a small papilloma at the left ureteral orifice; this was destroyed by fulguration. A diagnosis of papillary

[2] Cases 1 to 8 are from Scholl (see reference on page 246).

epithelioma of the left renal pelvis was made and operation advised. February 17, 1919, left nephro-ureterectomy was performed through a posterolateral and a low left rectus incision. Section of the kidney and ureter disclosed extensive papillary epithelioma of the renal pelvis, grade 2. November 7, a segmental resection of the bladder was performed for recurrent papillary epithelioma, about 2.5 cm. in diameter, of the left lateral wall. Recurrence developed and radium was applied May 10, 1920. The patient lived seven years after the first operation, dying in November, 1926.

Case 4. A man, aged forty-nine, came to the Clinic, September 5, 1919, on account of hematuria of eleven months' duration.

On cystoscopic examination the blood was found coming from the left kidney and exploration was advised for probable renal tumor. September 30, 1919, left nephrectomy and partial ureterectomy was performed for extensive papillary epithelioma of the renal pelvis, grade 2. Convalescence was satisfactory. September 3, 1920, the patient returned with recurrence of hematuria and frequency of urination. Cystoscopic examination revealed multiple papillomas around the left ureteral orifice. May 28, 1921, the bladder was resected and the remaining portion of the ureter removed for papillary epithelioma of the bladder and ureter. Numerous cystoscopic examinations since then did not reveal evidence of recurrence. The last cystoscopic examination was in 1925, approximately five and a half years since the nephrectomy. Evidence of recurrence was not found. The patient has not been heard from since 1925.

Case 5. A man, aged sixty-five, came to the Clinic, April 9, 1919, on account of intermittent hematuria of two years' duration. There had been, at times, sharp pains in the region of the left kidney.

On cystoscopic examination the bladder mucosa was normal, however, obstruction was encountered about 12 cm. from the bladder. This was explored April 12, through an anterior incision. The ureter was opened and an organized blood clot escaped releasing the urine from a hydronephrotic sac. One month later the function of the left kidney had returned practically to normal, however, the pyelogram disclosed marked hydronephrosis. The patient did not desire operation at this time, but returned to the Clinic, March 8, 1920, on account of severe hematuria and pain in the left side. Cystoscopic examination again showed that the bladder mucosa was normal; however, hemorrhagic

urine was seen coming from the left kidney. On a diagnosis of hydronephrosis and possible renal tumor left nephrectomy was performed March 12, with removal of about 10 cm. of the upper portion of the ureter for tumor of the left kidney. The kidney weighed 490 grams. Section of the kidney showed extensive papillary epithelioma, grade 2, involving the whole renal pelvis. Convalescence was uneventful and the patient was dismissed from the hospital on the fourteenth day. A recent report from the patient, who is a practicing physician, states that he is perfectly well, and has had no recurrence of hematuria and no other untoward urinary symptoms.

Case 6. A man, aged forty-six, came to the Clinic, October 23, 1920, on account of hematuria and frequency. The hematuria had been intermittent for four years.

On cystoscopic examination multiple papillomas were found scattered throughout the bladder. November 23, the bladder was resected and 2 cm. of the lower part of the ureter was removed for extensive papillary epithelioma, grade 2, involving most of the bladder wall and base. This was believed to be secondary to papillary epithelioma of the left kidney. Consequently left nephrectomy and ureterectomy was performed December 6. A definite papillary epithelioma of the renal pelvis, grade 2, producing marked hydronephrosis was found. The patient died ten months later from extensive recurrence in the bladder.

Case 7. A man, aged sixty-one, came to the Clinic, February 10, 1921, on account of pain in the area of the left kidney, and frequency and hematuria, of two years' duration.

A large tumor was palpated in the upper left quadrant of the abdomen. On cystoscopic examination a tag of papilloma was seen protruding from the left meatus. The left kidney did not function. Left nephrectomy was performed February 23, 1921, through an anterior transperitoneal incision. The kidney was about 25 cm. in diameter. A large papillary epithelioma, grade 2, caused marked hydronephrosis and destruction of renal tissue. The patient died five months after the operation.

Case 8. A man, aged forty-eight, came to the Clinic, February 6, 1922, on account of hematuria. A tumor of the bladder had been fulgurated ten months previously at which time cystoscopic examination disclosed a papilloma of the left wall of the bladder and a non-functioning right kidney.

A diagnosis of papillary epithelioma of the right kidney was made and nephrectomy advised. February 16, 1922, right nephrectomy and partial right ureterectomy was performed. Section of the kidney disclosed a papillary epithelioma of the pelvis, grade 2. June 26, 1922, the remaining portion of the ureter was removed including a small portion of the wall of the bladder, immediately around the ureteral orifice. The lower portion of the ureter was not involved. The patient died two and one-half years after operation from recurrence in the bladder.

Case 9. A man, aged sixty-two, came to the Clinic, August 7, 1922, on account of a mass in the upper right quadrant of the abdomen which he had first noticed four months previously. The mass had gradually increased in size. Irregular hematuria and slight frequency had been present for the last six months.

A large mass in the right upper quadrant of the abdomen was believed to be in the right kidney. A passed specimen of urine contained a few red blood cells and pus cells. The hemoglobin was 73 per cent, the erythrocytes numbered 4,600,000 and the leucocytes 10,500. The combined phenolsulphonephthalein test showed a return of 40 per cent of the dye in two hours. The blood urea was 16. Roentgen-ray examination of the kidneys, ureters and bladder was negative. Cystoscopic examination disclosed normal bladder mucosa. A diagnosis of right hydronephrosis with a possibility of primary neoplasm was made. August 12, 1922, the right kidney was removed through an anterior transperitoneal incision. The kidney was densely adherent and markedly hydronephrotic, as a result of obstruction at the ureteropelvic juncture by a papillary epithelioma, grade 2. The growth was scattered throughout the entire inner surface of the tremendously dilated pelvis. The patient's convalescence was satisfactory and he was dismissed from the hospital on the twenty-fifth day. His home physician recently informed us that he died March 23, 1927, four and a half years after operation, presumably from recurrence of the lesion in the bladder.

Case 10. A woman, aged fifty-four, came to the Clinic June 17, 1924, on account of tumor in the left side of the abdomen, and hematuria. The hematuria had been intermittent for the last two years; there were no other urinary symptoms. The tumor had been noticed first two months previously and had increased in size.

The systolic blood pressure was 195 and the diastolic 90. A large tumor, apparently renal, practically filled the upper left quadrant of the

abdomen and extended through the back. A passed specimen of urine contained a great many red blood cells and a few pus cells. The hemoglobin was 51 per cent, the erythrocytes numbered 3,820,000 and the leucocytes 8400. The combined phenolsulphonephthalein test showed a return of 50 per cent of the dye in two hours. Roentgen-ray examination of the kidney, ureters and bladder was negative. Cystoscopic examination of the bladder was negative, however, the differential functional test did not show function from the left kidney, and in the pyelogram the calices were markedly dilated and the pelvis of the kidney deformed. A diagnosis of neoplasm of the left kidney was made and operation advised. On removal of the large renal tumor tuberculosis of the spleen was discovered and the spleen was removed through an anterior incision. The spleen was about three times normal size. About 60 per cent of the renal tissue had been destroyed as a result of obstruction at the ureteropelvic juncture by a huge papillary epithelioma, grade 3. The patient's convalescence was satisfactory and in a recent report nearly three years after operation she states that she is perfectly well without evidence of recurrence.

Case 11. A woman, aged sixty-five, came to the Clinic, February 4, 1926, on account of hematuria of two weeks' duration and pain in the right side of the back which for the last two weeks had been severe. She had lost about 12 pounds in weight in the last month. The systolic blood pressure was 122 and the diastolic 85.

A general physical examination was practically negative. In a passed specimen of urine there were a great many red blood cells and a few pus cells. The hemoglobin was 73 per cent; erythrocytes numbered 4,240,000 and leucocytes 5800. The combined phenolsulphonephthalein test showed a return of 56, and the blood urea was 60 mgm. Roentgen-ray examination of the kidney, ureters and bladder, and cystoscopic examination of the bladder were negative. Both ureteral meatuses were normal. Differential functional test showed reduction of function of the right kidney to about half that of the left. The pyelogram of the right kidney was bizarre and showed a filling defect in the pelvis with moderate dilatation of the ureter. A diagnosis of neoplasm of the pelvis of the right kidney was made. February 8, 1926, the right kidney was removed with the upper third of the ureter. The tumor 1 by 2 cm. in diameter was in the ureter about 2.5 cm. below the pelvis of the kidney. Section of the kidney and ureter disclosed papillary squamous-cell epithelioma, grade 3 (fig. 11). Complete ureterectomy was considered

but the patient's general condition hardly justified so radical a procedure at this time. Six months later, there was recurrence of hematuria. Cystoscopic examination was negative so far as the bladder was concerned, however, a specimen removed from the right ureter and examined microscopically proved to be papillary squamous cell epithelioma. Ureterectomy was advised but the patient deferred the operation until November 1, at which time the remaining portion of the ureter was removed and segmental resection of the bladder performed. On account of scar tissue the result of a previous operation in the lower part of the abdomen, transperitoneal resection of the bladder and extirpation of the ureter was necessary. The ureter was about 1 cm. in diameter and was completely filled with papillary epithelioma of the same grade of malignancy as the primary lesion in the upper portion of the ureter.

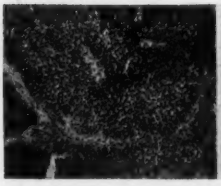

FIG. 11.

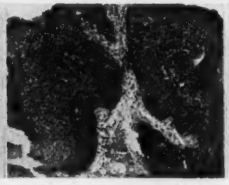

FIG. 12.

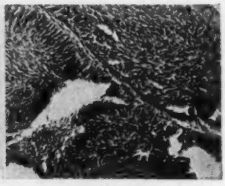

FIG. 13.

FIG. 11. PAPILLARY EPITHELIOMA, GRADE 3
FIG. 12. PAPILLARY EPITHELIOMA, GRADE 2
FIG. 13. PAPILLARY EPITHELIOMA, GRADE 2

The operation was undertaken with considerable risk on account of the necessity of the transperitoneal resection. Severe reaction followed the operation and the patient died from general peritonitis on the thirteenth day. Necropsy did not disclose evidence of metastasis.

Case 12. A woman, aged fifty-seven, came to the Clinic, March 12, 1926, because of intermittent hematuria of ten months' duration, more frequent in the last three months. Slight pain had been noted in the area of the right kidney.

The systolic blood pressure was 152, the diastolic 94. General physical examination was negative except for the appearance of anemia. A passed specimen of urine was almost pure blood. The hemoglobin was 58 per cent, erythrocytes numbered 3,630,000, the leucocytes 5900, and the color index was 0.8. The blood Wassermann reaction was negative.

Blood urea was 24 mgm. Roentgen-ray examination of the kidneys, ureters and bladder, and cystoscopic examination of the bladder mucosa were negative. The ureteral orifices appeared normal except for an area of inflammation around the right orifice and hemorrhagic urine escaping from it. Catheterized specimens of urine from the kidney contained a large number of red blood cells but no pus cells. The differential functional test of the right kidney showed material reduction in function. A diagnosis was made epithelioma of the right renal pelvis. March 19, 1926, the kidney with the upper 15 or 16 cm. of the ureter was removed. There was slight hydronephrosis. The papillary epithelioma, grade 4, was found to be primary in the pelvis. The ureter was not involved.

Convalescence was satisfactory and the patient was dismissed from the hospital on the eighteenth day. She returned to the Clinic February 7, 1927, on account of hematuria. Her progress had been satisfactory for six months following the nephrectomy, when intermittent hematuria appeared and gradually increased in severity. Examination showed an elevation of the blood pressure; systolic 184 and diastolic 110. The patient had been less anemic, the hemoglobin at this time being 70 per cent, erythrocytes 4,340,000 and leucocytes 6600. A passed specimen of urine again contained a large amount of blood. The combined phenolsulphonephthalein test showed a return of 55 per cent of the dye. On cystoscopic examination a tumor about 4 by 2 cm. in diameter surrounding the right ureteral orifice was found; it appeared pedunculated and of the papillary type. Operation was performed February 14, through a low median line incision. The ureter was approached extraperitoneally. It was found to be more or less solid and purplish, apparently due to old blood, and the presence of the papillary epithelioma, and was about 1 cm. in diameter. It was freed down to the bladder and a segmental resection of the bladder performed with excision of the papillary tumor surrounding the ureteral orifice, which was about 3 cm. in diameter; this excision included a transplant about 1 cm. in diameter situated just above the major growth. The resected segment of the bladder was left attached to the ureter which was wrapped up in gauze and removed with the remainder of the ureter intact. The bladder was reconstructed and drained suprapubically. Microscopic examination of the growth in the ureter and the bladder showed grade 4 papillary epithelioma, the same as the primary lesion in the renal pelvis. Convalescence was satisfactory until the afternoon of the tenth day when a moderately severe attack of pulmonary embolism occurred. The pa-

tient rallied but died in a second attack early the following morning. At necropsy it was seen that the pulmonary embolism originated in the right iliac vein.

Case 13. A man, aged forty-two, came to the Clinic, December 27, 1926, because of occasional attacks of hematuria during the last year. One month previously excruciating pain appeared in the right lumbar region, and recently severe hematuria.

Physical examination showed nothing referable to the urinary tract. The systolic blood pressure was 150 and the diastolic 95. There were many red blood cells in a passed specimen of urine and a moderate number of pus cells. The combined phenolsulphonephthalein test showed a return of 60 per cent of the dye. Roentgen-ray examination of the kidneys, ureters and bladder was negative. Cystoscopic examination showed normal bladder mucosa but marked turbidity of the urine from the right ureter. A differential functional test showed reduction of about one-third function of the right kidney with marked irregularity of the pelvis, suggestive of papillary epithelioma of the pelvis of the right kidney and ureter. January 7, 1927, right nephrectomy and partial right ureterectomy was performed, with removal of the upper 10 cm. of the ureter. It was recommended that the remaining portion of the ureter be removed in about two weeks. Section of the kidney showed papillary epithelioma, grade 2. Two weeks later, through an anterior incision the remaining portion of the ureter was removed down to the bladder. There was no involvement of this portion of the ureter. Convalescence was entirely uneventful and the patient was dismissed from the hospital on the nineteenth day.

Case 14. A woman, aged forty, came to the Clinic, January 29, 1927, on account of hematuria, pain in the left side of the back, and a tumor. Ten days previously severe hematuria had occurred, the bleeding lasting twenty-four hours. The urine was still highly colored at the time of admission. The hematuria had been preceded for four days by frequency and dysuria.

The patient weight 200 pounds. The systolic blood pressure was 135 and the diastolic 80. A mass was palpated in the area of the left kidney apparently three or four times the size of a normal sized kidney, over which there was considerable tenderness. A passed specimen of urine contained red blood cells, grade 2, and pus cells, grade 2. The hemoglobin was 73 per cent, the erythrocytes numbered 4,430,000

and the leucocytes 8500. The blood Wassermann reaction was negative. The combined phenolsulphonephthalein test showed a return of 35 per cent of the dye. Blood urea was 24. Roentgen-ray examination of the kidneys, ureters and bladder was negative except for the outline of a large left kidney. On cystoscopic examination the tumor about 4 by 6 cm. in diameter was found in the left wall of the bladder and surrounding the left meatus. It was pedunculated and villous. A specimen removed through the cystoscope proved to be papillary squamous-cell epithelioma, grade 2. The major portion of the tumor was removed by fulguration. There was an absence of indigo-carmin from the left kidney and a diagnosis of left hydronephrosis was made secondary to papillary epithelioma. February 11, a low median-line incision was made through which the ureter was isolated extraperitoneally and a segmental resection of the bladder (about 3 cm.) performed. The ureter was about 1 cm. in diameter and was almost black apparently as a result of old blood and the presence of the papillary epithelioma. It was freed and the resected segment of the bladder left attached to the ureter, was wrapped in gauze, and pushed up extraperitoneally toward the kidney, after which the bladder was reconstructed and drained suprapubically. The incision was then closed, the patient turned on the side and the kidney, which was about three times normal size and simply a hydronephrotic sac, was removed through a left posterolateral incision together with the entire ureter and resected segment of the bladder. The primary papillary epithelioma of the pelvis of the kidney was about 1 cm. in diameter. The ureter was extensively involved throughout from the ureteropelvic juncture to the ureteral orifice and the bladder mucosa was involved for about 1 cm. Microscopic examination of the primary lesion of the renal pelvis as well as that of the ureter and bladder did not show changes in the degree of malignancy with progression downward of the growth. The lesion throughout was of grade 2 malignancy (fig. 12). Convalescence was considerably prolonged as a result of moderate infection in both wounds, however the patient was dismissed from the Clinic at the end of the fourth week with both wounds practically healed. There has been no hematuria; however only three months have elapsed since the operation.

Case 15. A man, aged forty-four, came to the Clinic, February 16, 1927, complaining chiefly of hematuria. In 1916 left renal colic with hematuria had occurred, but no subsequent trouble until eighteen months previously when the pain and hematuria recurred. A pyelo-

gram made at this time disclosed a distorted left renal pelvis, and reduced function of the kidney.

The urine contained a few red blood cells and a large number of pus cells. The combined intravenous phenolsulphonephthalein return was 60 per cent. The blood urea was 26. Roentgen-ray examination of the kidneys, ureters and bladder was negative. Cystoscopic examination disclosed a normal bladder, but a catheterized specimen of urine from the left kidney contained red blood cells and pus cells 2 (on the scale of 1 to 4). The pyelogram showed marked deformity of the pelvic outline, apparently a filling defect, so that most of the calices and a portion of the pelvis was obliterated. The outline of the pelvis was apparently dilated and the upper portion markedly irregular, suggestive of tumor-tissue protruding into the pelvis. A diagnosis was made of papillary epithelioma of the pelvis and operation recommended. February 22, 1927, the left kidney, ureter and segment of the bladder surrounding the left ureteral orifice was removed. The ureter was normal throughout; the papillary epithelioma, grade 2 (fig. 13), was limited to the renal pelvis. Convalescence was satisfactory and the patient was dismissed from the hospital on the twenty-first day.

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RENAL TUMORS

A CLINICO-PATHOLOGICAL STUDY

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On reviewing the end results of cases of renal tumor treated in the Urological Service of the Peter Bent Brigham Hospital an unexplained difference in the duration of life after operation, or in the date at which metastases became evident, was found to exist. Excluding all those instances where the growth was found to have already taken on invasive character, as well as those in which lymph nodes about the renal pedicle and aorta were found the seat of secondary deposit, there still lacked evidence on which to base an opinion as to the clinical prognosis. In other words, in not a few instances, apparently favorable for cure, metastases and death have taken place at a relatively short period after operation—and this in cases which had been carefully studied by x-ray of lungs and bones for metastases before operation, and in whom the localized character of the tumor as seen at operation gave every hope of cure or at least long freedom from metastases.

It was, therefore, hoped that a renewed study of the pathological appearance of the tumor as seen by the microscope, correlating this appearance with the clinical result, might serve to give added evidence as concerns prognosis.

Of the group of 43 cases on record at the time this investigation was undertaken there were 35 in which intensive pathological study was possible. This was made by Dr. L. E. Kindall (of Oakland) with the advice and assistance of Dr. S. B. Wolbach, Pathologist to the hospital.

The cases are divided as follows:

	Number
I. Primary adrenal carcinoma	3
II. Adenocarcinoma of kidney	1

	Number
III. Carcinoma of renal pelvis	2
IV. Carcinoma of renal pelvis (associated with another type of tumor in the same kidney)	2
V. Adenoma of kidney	2
VI. Papillary adenocarcinoma of renal pelvis (malignant papilloma)	1
VII. Renal tumor of hypernephroma type	24

PATHOLOGICAL DATA

As will be seen from this classification, those tumors of the kidney of the so-called hypernephroma type are in the large majority, and, as is well known, concerning their origin and pathological character much has been written, but thus far there is no general agreement among pathologists on these points. For clinical purposes, however, the origin of the tumor is but of relatively small significance. Such tumors show on detailed microscopy so many differing cell structures and types of cell that it is only to be expected that confusion will exist. Their common feature is a cell with high lipin content. With the usual stains such cells appear to be pale and clear or finely vacuolated. We attach no especial importance to the arrangement of cells in the tumor, however, for columnar, tubular, alveolar or papillary arrangement may all be present in the same tumor. An important feature is that we have here a group of tumors consisting of one type of cell evidently of renal (adrenal?) cell origin. Loss of definite arrangement of cell in the tumor as a whole, or in portions of it, together with the appearance of solidly staining polymorphous and spindle-shaped cells, seems to be an infallible criterion of a high degree of malignancy. Giant cells and cells showing mitoses are not infrequent, but here do not seem to have the significance as regards malignancy as have such appearances in other types of tumor. One portion of the tumor may seem to be of fairly orderly arrangement while an adjacent area may show an entirely confused picture.

The most outstanding evidence of malignancy being then, the loss of any definite arrangement by the cells and the appearance of spindle-shaped cells, these criteria were applied to our cases in an effort to give them some sort of pathological grouping regarding

the degree of expected malignancy. Comparison of this with the clinical end results, especially as regards those patients still alive, entirely failed to show any agreement. We are forced thus to conclude that our attempted correlation has been an entire failure, and that there is no very significant pathological data on which a prognosis may be based.

CLINICAL RESULTS

In thirty-one instances a nephrectomy has been performed with the result that thirteen patients are still living; sixteen are dead; and of two we have no information. Nine patients were alive and without recurrence at the time of this report at the following intervals after operation:

10 years	1
8 years	1
6 years	2
5 years	1
4 years	1
3 years	1
1 year	1
4 months	1

Four other patients are alive, but have recurrences. It is of interest to note that in two of these recurrence was very late—in the one nine years; in the other seven years after operation—and in each instance it took place in the region of the scar of operation.

It is of interest to review the type of tumor shown by this group of 9 cases apparently well.

1. In one instance the tumor was found to be a papillary adenocarcinoma of the renal pelvis, in many respects the same type of tumor as is the so-called malignant papilloma of the bladder. Such types are rarely very malignant, and in the kidney, as in the bladder, a local removal is usually sufficient for a cure.

2. There were two instances of renal adenoma. This is in all probability a benign type of tumor. As in 1 of our cases, it may reach a huge size, but apparently entirely without invasive character.

3. There remain six instances of tumor of the hypernephroma type in which as suggested above, no indication is to be had from the slides that a favorable prognosis was to be expected. They have survived operation, however, for the following lengths of time: ten years, six years, five years, four years, three years, and four months.

GENERAL DESCRIPTION OF 43 CASES

Thirty of the patients were men, thirteen were women. The presenting symptom was pain in 29 cases, tumor in 25 cases, and hematuria in 28 cases. Examined microscopically, the urine showed red blood cells in thirty-nine instances. In thirty of the patients there was slight fever; a finding also frequent in deep-seated malignancy of other organs and areas than the kidney. Sixty-two per cent of the patients were of the age group of from fifty to sixty-nine years inclusive and 88 per cent fell in the group of those forty years old and over. Only twelve of this whole group of patients appeared for investigation within three months after the appearance of symptoms, and in this regard the delay in reaching a proper diagnosis—not always the fault of the patient—is deplorable. One of our patients had bled intermittently for sixteen years, and five had had symptoms for from five to fifteen years.

In three instances renal calculus was associated with the renal tumor.

OPERATION

We have come to feel more and more convinced that the only adequate route of operative approach to renal tumors is through the open peritoneal cavity, with the object of reaching and tying the vascular pedicle as the first step in the procedure of nephrectomy. This is most efficiently done by a transverse incision from the costo-vertebral angle, across the abdominal wall to the midline, which is then prolonged upward in the line of the linea alba to the ensiform. Such an incision going through all the thickness of the abdominal wall allows a flap to be swung upward and outward on the axis of the costal margin, and gives adequate

exposure. The colon is then dissected from the anterior surface of the tumor, turned toward the midline and the vessels identified and tied. If there be any adhesion of peritoneum to the tumor, this peritoneum should also be removed. The whole tumor and kidney can then be withdrawn from the renal fossa, frequently together with the adrenal, and always with all fatty tissue.

CONCLUSIONS

1. There is no adequate pathological criterion on which to base a prognosis as regards the duration of life after nephrectomy for renal neoplasm.
2. The size of a renal tumor is not a reliable indication of its character in respect to its degree of malignancy. Occasionally an entirely benign adenoma may reach large size.
3. Primary ligation of the vascular pedicle by transperitoneal approach is the most logical method of operative attack on such growths.

ABSTRACTS OF CASES

Case 57. A man, aged forty-two, entered in 1913 complaining of pain and a tumor mass in the left upper abdomen and hematuria of one year's duration. He had lost 30 pounds in three months; had a hemoglobin of 94 per cent; blood pressure of 105. Cystoscopic examination revealed bleeding from the left ureteral orifice and renal function zero on the left side and 51 per cent on the right side. A pyelogram could not be made because the ureter was blocked. A nehprectomy was performed. The kidney was very large, measuring 20 by 12.5 by 6 cm., and was irregular and nodular with a yellowish discoloration. The pelvis was distended with a thin, reddish material and fat. *Diagnosis:* Hypernephroma, clear papillary cells. Nine years later the patient appeared at the Johns Hopkins Hospital with a large, palpable tumor mass in the left upper abdomen, a recent loss of weight, and a hemoglobin of 75 per cent. An x-ray of the chest was negative. There were no enlarged glands. The patient was not treated.

Case 5137. A man, aged fifty-six, entered in 1916 complaining of a tumor mass in the right upper abdomen and hematuria of one year's duration. He had lost 40 pounds in the past year, had a hemoglobin of

65 per cent, and a blood pressure of 118/70. The patient had urethral strictures and while being investigated in the hospital his bladder became distended with urine and blood clots requiring immediate suprapubic drainage. Later a nephrectomy was performed. The tumor mass involved the lower half of the kidney and measured 10 by 9 by 4 cm. The tumor had invaded the pelvis and efferent vein. *Diagnosis:* Hypernephroma, clear cells with alveolar and tubular arrangement. Immediately following operation a duodenal fistula developed by extension of the tumor growth. An attempt to close the fistula failed. Later transection of the stomach and gastro-enterostomy was performed but the patient died the following day; six weeks after the nephrectomy.

Case 6857. A woman, aged thirty-six, entered in 1917 complaining of a tumor mass in the left upper abdomen of nine years' duration. She had slight fever, a few red blood cells in the urine, a hemoglobin of 85 per cent, and blood pressure of 140/80. She had lost 10 pounds in two years. The functional capacity was 11 per cent from the left kidney and 10 per cent from the right in ten minutes. A pyelogram revealed no outline of the pelvis. A nephrectomy was performed. The gross specimen showed the lower two-thirds of the kidney replaced by a soft, encapsulated, irregular tumor mass measuring $12\frac{1}{2}$ by 10 cm. There was no extension of the tumor into the renal vein or pelvis. *Diagnosis:* Hypernephroma, clear celled, columnar. In 1927, ten years after the nephrectomy, the patient was entirely well.

Case 6930. A woman, aged fifty-seven, entered in 1917 complaining of pain and a tumor mass in the left abdomen of six months' duration. Examination of the urine showed a few red blood cells. She had lost no weight, the hemoglobin was 60 per cent, and the blood pressure was 130/75. The functional capacity of the left kidney was greatly diminished. A nephrectomy was performed. The kidney was mostly replaced by a soft, encapsulated tumor measuring 25 by 20 by 10 cm. The tumor had not invaded the pelvis. *Diagnosis:* Hypernephroma, clear cells, alveolar and tubular arrangement. Two years later the patient was not feeling well, complained of pleuritic pains in the left chest and also had swollen glands in the neck. Further information is unobtainable.

Case 6964. A woman, aged twenty-eight, entered in 1917 complaining of pain in the right kidney region of six years' duration. Examination

of the urine revealed many red blood cells. The blood pressure was 120/80; the hemoglobin was 80 per cent; and she had lost no weight. Cystoscopic examination showed a normal bladder wall and ureteral openings, and a functional capacity of 4 per cent on the right and 17 per cent on the left side in fifteen minutes. A nephrectomy was performed. The kidney was normal in size but presented at the upper pole an encapsulated tumor 2½ cm. in diameter. *Diagnosis:* Hypernephroma, clear cells with alveolar and tubular arrangement. The patient wrote three years later that she had entirely recovered.

Case 6996. A man, aged sixty-two, entered in 1917 complaining of pain in the left kidney region of three weeks' duration. The urine contained a few red blood cells, and hyaline and granular casts. He had lost no weight; had a hemoglobin of 87 per cent; blood pressure of 140/75; and temperature of 101°. During cystoscopic examination considerable blood was expelled from the left ureter on catheterization. The functional capacity was 10 per cent on the right side and 2½ per cent on the left side. A nephrectomy was performed. The kidney presented a tumor mass on the anterior, central portion about 7 cm. in diameter, which had invaded the pelvis. *Diagnosis:* Hypernephroma, granular, clear, spindle cells, alveolar and columnar arrangement. The patient died twenty-eight days later of bronchopneumonia. Autopsy showed metastatic nodules in the intestinal wall, liver, pleura, mediastinum, endocardium, lung tissue, left adrenal, right kidney, and bronchial lymph glands. The renal vein was clear.

Case 8318. A woman, aged fifty-seven, entered in 1918 complaining of pain in the right kidney region of five years' duration, and a tumor mass for the past year. The urine contained many red blood cells. The patient had lost considerable weight in the past two years. She had a fever averaging 101°; and had a hemoglobin of 50 per cent and blood pressure of 105/80. Function on the right side was zero. The patient had a severe cardiac condition with probable metastasis in the lungs. No operation was attempted. The patient died in January, 1919, several months after her entrance to the hospital.

Case 8539. A man, aged fifty-five, entered in 1918 complaining of hematuria and pain in the right kidney region of two years' duration. He had lost 5 pounds during the previous year. The blood pressure was 150/90; and the hemoglobin 80 per cent. The urine contained many

red blood cells. Cystoscopic examination showed blood and clots expelled from the right ureteral orifice, and a functional capacity of zero on the right side and 14 per cent on the left in ten minutes. A nephrectomy was performed. The gross kidney specimen showed an irregular, nodular tumor mass measuring 13 by 9 by 5.5 cm. and in the pelvis numerous small calculi. *Diagnosis:* Adenoma of adrenal gland origin, of very uniform structure. In May, 1921, the patient entered the hospital for a hernia operation at which time an x-ray of the lungs was negative for metastasis. In March, 1926, the patient reported in person and was found in excellent condition with no evidence of metastasis.

Case 9620. A woman, aged fifty-eight, entered in 1918 complaining of hematuria and pain in the left kidney region of four years' duration. Upon examination a large tumor mass was palpated in the left upper abdomen. The temperature averaged around 101°. The blood pressure was 180/100; and hemoglobin was 85 per cent. She had lost 12 pounds during the past year. The function of the left kidney was zero. A pyelogram of the left kidney showed the calices retracted and thinned. A nephrectomy was performed. The gross specimen showed most of the kidney substance replaced by a lobulated tumor mass measuring 17 by 12 by 7 cm. which had invaded the renal vein and pelvis. *Diagnosis:* Hypernephroma, clear cells with alveolar and tubular arrangement. Following operation the patient gained 50 pounds in weight and felt well except for occasional lumbar pains. Nineteen months later she reentered the hospital complaining of recent loss of weight and severe lumbar pain. X-ray at this time showed metastasis in the left lung, 10th and 11th dorsal vertebrae, temporoparietal and occipital regions of the skull. The patient died three months later.

Case 10046. A man, aged thirty-six, entered in February, 1919, complaining of pain in both thighs of five months' duration and a tumor of the skull which appeared after striking his head on a beam. Urine examination revealed many red blood cells. He had a slight fever; the blood pressure was 144/90; the hemoglobin was 75 per cent; and he had lost 10 pounds in six months. Cystoscopic examination showed blood and clots expelled from the right ureteral orifice. Only a small amount of dye was given off from the right side. A pyelogram of the right kidney showed characteristic distortion of the renal pelvis and calices. A nephrectomy was not performed because of the skull metastasis. Three

weeks after discharge he became paralyzed below the waist and died in May, 1919.

Case 11016. A woman, aged fifty-nine, entered in August, 1919, complaining of hematuria of eleven months' duration. The temperature was 99°; blood pressure 210/100; and hemoglobin 45 per cent. Cystoscopic examination showed blood expelled from the left ureteral orifice. A pyelogram of the left kidney showed a blunting of the calices, the pelvis enlarged, circular and irregular, and the ureter pushed outward. A nephrectomy was performed. The gross specimen showed a tumor mass occupying the central portion of the kidney measuring 7 by 4 by 5 cm. and entirely filling the pelvis. *Diagnosis:* Hypernephroma, clear papillary. In February, 1926, the patient reported in person. She was anemic, had lost considerable weight, had a recurrence of the tumor in the incision, a dry cough, and pain in the dorsal spine.

Case 11076. A man, aged fifty-seven, entered in September, 1919, complaining of hematuria and pain in the right kidney region of ten months' duration. A tumor of the right kidney was found on examination. The temperature was 99°; the blood pressure 120/58; and the hemoglobin 64 per cent. He had lost 35 pounds in nine months. Cystoscopic examination showed blood from the right orifice with no function. An attempted pyelogram failed because the pelvis would not fill. A nephrectomy was performed. The gross specimen showed most of the kidney replaced by a lobular tumor mass measuring 12 by 10 by 10 em. and completely filling the pelvis in one place. *Diagnosis:* Hypernephroma, granular and clear cells, spindle cells, alveolar and columnar arrangement. The patient died nine months later of general metastases.

Case 11454. A man, aged sixty, entered in November, 1919, complaining of hematuria of three months' duration. The blood pressure was 162/92. He had lost no weight. Cystoscopic examination showed blood from the left orifice. The function of the left kidney was 4 per cent, and of the right kidney 20 per cent in fifteen minutes. A nephrectomy was performed. The gross specimen showed a large, distorted kidney measuring 18 by 13 by 8 cm., very nodular and irregular, soft, and yellow in color. The renal vein was not involved. *Diagnosis:* Hypernephroma, clear cells with alveolar and tubular arrangement. In March, 1923, the patient was well. After that he went to Sweden and no further word has been received from him.

Case 11567. A man, aged sixty-eight, entered in November, 1919, complaining of pain in the left thigh and testicle, and a large tumor mass in the left upper abdomen noted only a week before. Examination of the urine showed only a few hyaline and granular casts. Temperature ranged from 99° to 100°. The blood pressure was 176/90, and the hemoglobin 70 per cent. He had lost 30 pounds in four months. Cystoscopic examination showed the left ureter blocked, no dye excreted. The patient died two hours after the first operation of ligating renal vessels transperitoneally in a two-stage nephrectomy. No autopsy was performed.

Case 11585. A woman, aged twenty-nine, entered in November, 1919, complaining of pain and a tumor mass in the left kidney region of two weeks' duration. The temperature was 99°; the blood pressure 122/70; and the hemoglobin 70 per cent. She had lost five pounds in one month. A pyelogram of the left kidney showed an elongation of the lower major calices. The patient died suddenly with symptoms suggesting mesenteric embolism before operation was attempted. An autopsy was refused. *Diagnosis:* Probably hypernephroma.

Case 12324. A man, aged forty-nine, entered in April 1920, complaining of pain and a tumor mass in the right kidney region of one month's duration. He had lost 5 pounds in six months. The temperature was 100°; the blood pressure 142/58; and the hemoglobin was normal. A nephrectomy was performed. The gross specimen showed a large, encapsulated tumor measuring 16 by 10 by 8 cm. On opening the tumor it was found to consist essentially of a cystic cavity filled with a brownish red blood clot and friable necrotic tissue. The wall of the tissue was thin, composed of a fibrous tissue but scattered here and there were found islands of a yellowish, opaque, rather soft, medullary tissue suggesting adrenal tissue. *Diagnosis:* Primary adrenal carcinoma. The patient died three days postoperative. An autopsy was refused.

Case 12466. A man, aged fifty, entered in May, 1920, complaining of hematuria of five months' duration. The temperature was 100°; the blood pressure 130/90; and the hemoglobin 85 per cent. He had lost five pounds in three months. Cystoscopic examination showed blood from the left orifice. A pyelogram of the left kidney showed a grape-like form and elongation of the calices. A nephrectomy was performed. The gross specimen showed a large kidney measuring 15 by

7 by 6 cm., the lower pole replaced by a resistant, irregular and nodular tumor mass. The pelvis and vein were normal. *Diagnosis:* Hypernephroma, clear cells with tubular and alveolar arrangement. In February, 1926, he was reported well.

Case 13235. A man, aged fifty-two, entered in September, 1920, complaining of hematuria of six weeks' duration. His temperature was 99°; blood pressure 150/90; and hemoglobin 90 per cent. The function of the right kidney was zero. A pyelogram of the right kidney showed a marked hydronephrosis with dilated calices. A nephrectomy was performed. The gross specimen, on longitudinal section, showed a large papillary, fungating growth involving the greater part of the pelvis and extending 3 cm. down the ureter. A second type of tumor involved the lower pole of the kidney. This was of solid growth and not encapsulated. *Diagnosis:* Malignant papilloma of the renal pelvis; papillary adenoma of the kidney. Subsequent history: In January, 1924, was operated on in another hospital for papilloma of the bladder. Last report, February, 1924, patient was making a good convalescence.

Case 13239. A man, aged fifty-two, entered in September, 1920, complaining of hematuria and pain in the left kidney region of one year's duration. The temperature was 99°; the blood pressure 140/85; and the hemoglobin 90 per cent. He had lost 23 pounds in the past year. A cystoscopic examination showed blood from the left orifice. The function of the left kidney was zero. A pyelogram showed no calices in the superior pole, and a distortion of the lower calices. A nephrectomy was performed. The gross specimen showed a yellowish irregular, lobulated tumor mass measuring 4 by 3.7 by 1.3 cm. projecting from the lower pole. On longitudinal section there was a cauliflower, fungating tumor mass arising apparently from the pelvis and filling the upper half of the pelvis. *Diagnosis:* Carcinoma of the pelvis with extension into the kidney. Hypernephroma of the kidney. In July, 1921, the patient died, probably from recurrence in the upper abdomen.

Case 13293. A man, aged forty-eight, entered in October, 1920, complaining of hematuria, pain, and a tumor of one year's duration. The temperature was 99°; the blood pressure 112/66; and the hemoglobin 85 per cent. The patient had lost 15 pounds in the past six months. The function of the right kidney was zero; of the left kidney it was normal. A two-stage nephrectomy was performed. *Diagnosis:* Hypernephroma,

clear celled, columnar. The patient died thirty-one days after the second-stage operation of pneumonia. The autopsy revealed miliary tuberculosis of the lungs, liver and spleen.

Case 13782. A man, aged sixty-one, entered in January, 1921, complaining of pain in the left kidney region of three weeks' duration. The urine showed red blood cells. The temperature was 99°; the blood pressure 125/78; and the hemoglobin 80 per cent. He had lost 15 pounds in the past year. The function of the left kidney was only a trace, while the right kidney was normal. A pyelogram showed a filling defect in the superior calyx. An exploratory operation showed a very large tumor, which was not removed because of neighboring metastatic infiltration of the tissues. *Diagnosis:* Hypernephroma, granular and clear cells, spindle cells, alveolar and columnar arrangement. The patient died one month later.

Case 14280. A man, aged seventy-one, entered in March, 1921, complaining of pain in the left kidney region of four and a half months' duration. The blood pressure was 140/80; and the hemoglobin 75 per cent. He had lost 65 pounds in four months. The urine did not show any red blood cells. The function of the left kidney was zero, but was normal on the opposite side. An attempted pyelogram failed because the solution would not enter the pelvis. An exploratory operation showed a large, adherent tumor. A section was removed for examination. *Diagnosis:* Carcinoma of the pelvis. The patient died eight days after operation. The autopsy revealed no metastasis.

Case 14710. A man, aged sixty-two entered in June, 1921, complaining of hematuria and pain in the left kidney region of sixteen years' duration. A tumor of the left kidney was easily palpated on examination. The temperature was 99°; the blood pressure 90/55; and the hemoglobin 35 per cent. The patient had lost 6 pounds in three months. Cystoscopic examination showed blood from the left orifice. Function on the left side was zero. The catheter would not pass up the ureter. A nephrectomy was performed. The gross specimen measured 22 by 13 by 11 cm. Most of the kidney substance had been replaced by the tumor. The lower half of the kidney had a large, irregular, lobulated tumor mass measuring 15 by 10 by 10 cm. There was also a smaller, rounded tumor 7 cm. in diameter in the upper pole. The pelvis was invaded. *Diagnosis:* Adenoma of the kidney. In April, 1926, the patient was well in every respect.

Case 15383. A man, aged fifty-four, entered in October, 1921, complaining of hematuria of two years' duration. A large tumor of the left kidney was found on examination. The blood pressure was 130/78; and the hemoglobin 80 per cent. He had lost 20 pounds in two years. The function of the left kidney was 3 per cent, and of the right kidney 7 per cent in ten minutes. X-ray showed a large left kidney. A pyelogram showed only one calyx filled. A nephrectomy was performed. The gross specimen showed a large kidney measuring 13 by 11 by 7 cm. The tumor mass lay in about its middle. On section the tumor was soft and pale yellowish in color. There was another tumor 1 cm. in diameter in the upper pole. *Diagnosis:* Hypernephroma, granular, clear, spindle cells, alveolar and columnar arrangement. The patient died one year later of acute alcoholism.

Case 16404. A man, aged sixty, entered in April, 1922, complaining of a tumor in the right kidney region of three years' duration and hematuria of two years' duration. The temperature was 99°; the blood pressure 110/60; and the hemoglobin 40 per cent. He had lost 40 pounds in two years. A pyelogram revealed a displaced right ureter with a small distorted pelvis. The patient had had a number of deep x-ray treatments during the past year and a half, following an exploratory laparotomy in Florida, where the surgeon told the patient he had a carcinoma of the liver. Surgery was not attempted. The patient died thirty-four days after admission to the hospital. At autopsy the right kidney was found to weigh 4 kilos, with a diameter of 21 cm. The tumor had replaced all normal kidney substance. It had invaded the veins and led to extensive thrombosis of the inferior vena cava, common iliac and external iliac veins. *Diagnosis:* Hypernephroma, clear celled columnar.

Case 17027. A man, aged sixty-five, entered in July, 1922, complaining of intermittent hematuria and a tumor mass in the left kidney region of fifteen years' duration. The urine was loaded with red blood cells. The temperature was 99°; the blood pressure 130/45; and the hemoglobin 24 per cent. At cystoscopy blood was seen escaping from the left ureteral orifice. At operation a first-stage mobilization was performed. The tumor was very large and had many venous collaterals. The operation was stopped because of the patient's poor condition. The patient died in thirty-six hours. An autopsy was refused.

Case 17102. A man, aged sixty, entered in August, 1922, complaining of pain in the right lower abdomen for three weeks, then pain in the right upper abdomen for one week. There was no blood in the urine. The blood pressure was 150/70; and the hemoglobin 80 per cent. He had lost 10 pounds in one month and was jaundiced. An exploratory operation revealed some blood in the peritoneal cavity and an enlarged liver, otherwise negative. The patient died six days later. Autopsy showed the right kidney normal. The left kidney was enlarged, about half being replaced by a moderately soft, whitish tumor, deeply infiltrating into the lower half of the kidney, while at the upper half necrotic tumor masses were sharply demarcated. The pelvis was not invaded. The renal veins were filled with the tumor. Extensive metastases were found in the liver and lungs. *Diagnosis:* Hypernephroma, granular, clear, spindle cells with alveolar and columnar arrangement.

Case 17647. A man, aged eighty, entered in October, 1922, complaining of hematuria of six months' duration. A tumor mass in the left kidney region was found upon examination. The urine was loaded with red blood cells. The temperature was normal; the blood pressure 160/85; and the hemoglobin 80 per cent. At cystoscopy blood was seen coming from the left ureteral orifice. Function on the right side was 12 per cent, on the left side 3½ per cent. The pyelogram revealed a filling defect in the lower part of the pelvis and lower calyx. A nephrectomy was performed. The gross specimen showed a kidney measuring 12 by 7 by 6 cm. The tumor was a soft, yellowish, nodular mass 5 cm. in diameter involving the middle lobe and pelvis. The veins were not involved. *Diagnosis:* Hypernephroma, granular, clear, and spindle cells, alveolar and columnar arrangement. During convalescence the patient had several attacks of Jacksonian epilepsy. Four months later he developed a hemiplegia and died ten months after the nephrectomy.

Case 18077. A woman, aged sixty-five, entered in January, 1923 complaining of a tumor in the left upper abdomen of ten years' duration and hematuria and pain of four months' duration. The urine was loaded with red blood cells. The temperature was normal; the blood pressure 210/100; and the hemoglobin 80 per cent. At cystoscopy a blood clot was seen at the left ureteral opening. The function of the left kidney was zero. A plain x-ray of the left kidney showed a large stone in the pelvis. The pyelogram failed because the mercuric iodide solution

would not enter the the pelvis. A nephrectomy was performed. The gross specimen showed a kidney measuring 14 by 8 by 6 cm. On section a yellowish tumor mass measuring 4½ cm. was seen in the lower pole. The pelvis was not involved. A vein in the upper pole contained a small nodule of tumor 3 mm. in diameter. *Diagnosis:* Hypernephroma, clear celled columnar. In February, 1926, the patient was well.

Case 18570. A man, aged fifty-seven, entered in April, 1923, complaining of hematuria and some frequency of urination for four months. The blood pressure was 150/85; and the hemoglobin 80 per cent. He had lost 35 pounds in two years. On cystoscopic examination it was impossible to enter the right ureter as there was a small shelf of reddened mucous membrane overhanging the orifice and causing deformity of the bladder in this area. A nephrectomy was performed. The gross specimen revealed a small, encapsulated, yellowish nodule 1½ cm. in diameter in the lower pole of the kidney. *Diagnosis:* Hypernephroma, clear cells with alveolar and tubular arrangement. The patient died seven days later of pulmonary embolism. Autopsy revealed a flat, indurated carcinoma 2½ cm. in diameter, in the bladder wall at the right ureteral orifice. The carcinoma of the bladder was no doubt the cause of the hematuria.

Case 18666. A man, aged seventy-five, entered in April, 1923, complaining of pain and a tumor mass in the right upper abdomen of one year's duration. The urine contained many red blood cells. The temperature was 100°; the blood pressure 140/40; and hemoglobin 50 per cent. At cystoscopy a blood clot was seen at the right ureteral orifice. The function of the right kidney was zero. A pyelogram of the right side was typical of tumor. An exploratory operation revealed a large, solid, vascular tumor of the right kidney, which was freed by blunt dissection, but as the patient's condition became bad on the table, the operation was stopped without the removal of the kidney. The patient was discharged home and died seven months later.

Case 19241. A woman, aged forty-six, entered in July, 1923, complaining of pain in the left kidney region of fifteen years' duration. A tumor mass in the left kidney was found upon examination. The urine was negative. The temperature was 99.6°; the blood pressure 145/80; and the hemoglobin 45 per cent. Cachexia was moderate. The pyelo-

gram showed a distorted pelvis. A two-stage nephrectomy was performed. The gross specimen showed a tumor weighing 1000 grams. It was irregular and made up of many nodules. The nodules were soft and yellow. *Diagnosis:* Primary adrenal carcinoma. The patient died the day after the second-stage nephrectomy. The autopsy revealed metastases to the lumbar lymph nodes, bronchial lymph nodes, and both lungs.

Case 20151. A man, aged fifty-four, entered in November, 1923, complaining of pain in the right kidney region of one year's duration. hematuria and a tumor of two weeks' duration. The urine contained many red blood cells. The temperature was normal; the blood pressure was 105/75; and the hemoglobin 100 per cent. He had lost 50 pounds in ten months. The pyelogram failed because of a blocked right ureter. Bilateral plain x-ray films showed a large, dense, coral-like shadow characteristic of calculi. A nephrotomy was performed, followed in three weeks by a nephrectomy. The gross specimen showed the right kidney weighing 1160 grams, irregular in shape. In cutting across the tumor two, rounded nodules were encountered which were white and very vascular. The tumor surrounded the inferior vena cava but did not involve it. *Diagnosis:* Carcinoma of the adrenal and kidney. The patient died seventeen days after the nephrectomy. The autopsy showed metastases to the lymph nodes, psoas muscle, peritoneum, liver, spleen, lungs, bronchial lymph nodes, heart, and stomach.

Case 20422. A man, aged forty-five, entered in January, 1924, complaining of hematuria and pain in the right groin of two years' duration. The urine was loaded with red blood cells. The temperature was 100°, the blood pressure 120/70; and the hemoglobin 50 per cent. He had lost 20 pounds in two months. Cystoscopic examination showed blood escaping from the right ureteral orifice. A pyelogram revealed a filling defect in the upper part of the pelvis. Operation revealed a large tumor mass with large, tortuous, venous collaterals. The tumor had broken through its capsule and had involved the retroperitoneal tissues and liver. The kidney was not removed. The patient died four months later.

Case 21655. A man, aged seventy-two, entered in June, 1924, complaining of hematuria of one month's duration. A tumor mass in the right kidney region was found upon examination. The urine was loaded

with red blood cells. The temperature was 100.2°; the blood pressure 140/70; and the hemoglobin 50 per cent. He had lost 10 pounds in three months. A pyelogram showed an irregular pelvic outline. A nephrectomy was performed. The gross specimen showed a slightly nodular, encapsulated, oval tumor attached to the lateral border of the kidney. The growth was projecting into the pelvis and veins. *Diagnosis:* Hypernephroma, clear celled columnar. Nine months later the patient returned feeling better, had gained in weight, but had a small tumor growth in the incision scar. Deep x-ray therapy was ordered. The patient returned a month later to have the growth removed. A section of the growth was removed. The pathological report was recurrent metastasis-hypernephroma. The patient died four months later.

Case 21923. A woman, aged fifty-eight entered in July, 1924, complaining of pain of two years' duration. She gave a history of falling downstairs and fracturing two ribs on the left side two years before. The urine contained a few blood cells. The temperature was 99.6°; the blood pressure 105/70; and the hemoglobin 75 per cent. She had lost 80 pounds in the past two years. A pyelogram showed a thinned-out pelvis and elongated upper calices. A nephrectomy was performed. The gross specimen showed a yellow, irregularly nodular tumor mass measuring 16 by 6 by 7½ cm. On section the tumor was found to be invading the pelvis and veins. *Diagnosis:* Hypernephroma, clear cells with alveolar and tubular arrangement. The patient died four months later.

Case 22578. A woman, aged twenty-eight, entered in November, 1924, complaining of hematuria and pain and a tumor of four and a half months' duration. The blood pressure was 118/70; and the hemoglobin 80 per cent. She had lost 7 pounds in five months. Cystoscopic examination showed blood coming from the right ureteral orifice. The function of each kidney was 10 per cent in ten minutes. A pyelogram showed a normal pelvis with a deformed upper calyx. A nephrectomy was performed. The gross specimen showed on section a firm, greyish white, encapsulated tumor mass measuring 6 by 5 cm. in the central portion of the kidney. The pelvis and veins were involved. *Diagnosis:* Adenocarcinoma of the kidney. The patient died five months later.

Case 24002. A man, aged sixty-six, entered in June, 1925, complaining of hematuria and pain in the right kidney region of three months'

duration. A large tumor mass of the right kidney was found upon examination. The blood pressure was 170/110; and the hemoglobin 80 per cent. He had not lost any weight. Cystoscopic examination showed blood from the right orifice. Function on the right side was zero. A pyelogram showed a distortion of the ureter at the pelvic junction and inferior calyx. A nephrectomy was performed. The gross specimen showed a rounded tumor mass 7½ cm. in diameter in the lower pole which was encapsulated. There was no evidence of extensive invasion. The pelvis and veins were negative for invasion. *Diagnosis:* Hypernephroma, granular, clear, and spindle cells, alveolar and columnar arrangement. Three and a half months later the patient reentered the hospital complaining of shortness of breath. X-ray revealed a metastasis of the left lung with fluid. The patient died one month later.

Case 24368. A woman, aged seventy-three, entered in July, 1925, complaining of hematuria of one year's duration. Her temperature was 101°; blood pressure 170/90; and hemoglobin 60 per cent. She had lost 10 pounds in the past year. Cystoscopic examination showed blood from the left orifice. A pyelogram demonstrated a filling defect of the upper pole. A nephrectomy was performed. Examination showed a tumor attached to one side of the pelvis. *Diagnosis:* Papillary adenocarcinoma of the renal pelvis. In March, 1926, the patient was reported well with no symptoms.

Case 24410. A man, aged sixty-seven, entered in July, 1925, complaining of hematuria and pain in the left kidney region of one year' duration. A tumor mass in the left kidney region was found upon examination. The urine was loaded with red blood cells. The temperature was normal; the blood pressure 140/78; and the hemoglobin 80 per cent. He had lost six pounds in one year. At cystoscopy blood was seen escaping from the left ureteral orifice. At operation the kidney was mobilized, but not removed because of local involvement of surrounding structures by new growth. On February 1, 1926, the patient's doctor reported that he was losing weight and gradually getting weaker.

Case 24497. A woman, aged sixty-five, entered in August, 1925, complaining of pain in the right kidney region of four months' duration. The urine contained red blood cells. The temperature was 99°; the

blood pressure 134/80; and the hemoglobin 80 per cent. She had lost 10 pounds in three months. At cystoscopy the right ureteral orifice was crater-like in shape but would not permit the passage of the ureteral catheter. A nephrectomy was performed. The gross specimen showed a kidney measuring 13 by 7 by 3.5 cm. On section the kidney was seen to consist of a series of irregular pockets surrounded by a thin shell of connective tissue. Practically no kidney tissue was recognized. *Diagnois:* Carcinoma of the pelvis. The patient left the hospital complaining of pain in the right leg, probably from metastasis involving nerve roots. She died four months later, having been in bed most of the time following her return home from the hospital.

Case 24958. A man, aged sixty-two, entered in October, 1925, complaining of hematuria and pain in the left kidney region of eight months' duration. A tumor mass in the left kidney region was found upon examination. The temperature was normal; the blood pressure 148/84; and the hemoglobin 80 per cent. He had lost seven pounds in eight months. At cystoscopy blood was seen escaping from the left orifice. A nephrectomy was performed. The gross specimen showed on the surface of the lower pole a yellowish, rough, irregular tumor 4 cm. in diameter. There was another tumor mass, dark red and pink in color, 10 cm. in its largest diameter, completely replacing the lower pole of the kidney. *Diagnosis:* Hypernephroma, granular, clear, and spindle cells, alveolar and columnar in arrangement. In February, 1926, the patient was reported well in every respect.

Case 25496. A man, aged forty-seven, entered in January, 1926, complaining of hematuria of six weeks' duration. The urine was loaded with red blood cells. The temperature was 99°; the blood pressure 180/100; and the hemoglobin 75 per cent. The patient had lost no weight. At cystoscopy blood and clots were seen escaping from the left ureteral orifice. The function of the left kidney was zero. A pyelogram of the left kidney showed a deformed pelvis with elongated and thinned-out calices and a mottled appearance suggesting a tumor. A nephrectomy was performed. The gross specimen showed a large, irregular, yellowish tumor completely filling the pelvis and involving the veins. *Diagnosis:* Hypernephroma. In April, 1926, the patient was getting weaker, losing weight, and having frequent emesis. He died three months later of metastasis in the spine.

PRIMARY TUMORS OF THE SUPRARENAL CAPSULE WITH ESPECIAL REFERENCE TO ADRENAL VIRILISM

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INTRODUCTION

Tumors of the adrenal associated with the development of the pseudo-hermaphroditic habitus are so infrequent as to make it the pleasant duty of any of us coming in contact with such cases, to report them,—that from the accumulated evidence we may ultimately draw conclusions respecting the etiology of the extraordinary associated clinical picture and possibly devise means for its prevention. For it is difficult to imagine anything much more distressing than to watch the gradual transition of a normal individual to one of these pitiable creatures. So that anything that may advance our knowledge of this condition is sufficient justification for the presentation of a case report.

The case I have to report is one which puzzled me a great deal at first. I admit that I was in complete ignorance of the effect of tumors of the adrenal cortex.

The patient, a woman of thirty-eight years, was referred to me by Dr. Hilbert F. Day of Boston, for pain in the left side accompanied by chills and fever with pus in the urine.

Past History. So far as she knows she was a normal, healthy female child. She began menstruating at thirteen and flowed regularly, except when pregnant, until she was twenty-nine years when it ceased and did not menstruate again until after her operation.

The patient was married at twenty-two years and in the following year she had two miscarriages, one at three months and one at five months. Her sexual desires, as far as she knows, were normal. Intercourse was always difficult on account of the size of the clitoris during sexual excitement. She was not aware that she was different from other women in this respect.

When she was about twenty years she began to grow an excess of hair on the face and abdomen. The hair on her face was so troublesome that she has had to have it pulled out at frequent intervals.

Present illness. One week ago she began to have marked frequency of urination with scalding. With this she has had fever and frequent chills. There has been dull pain in the left side of the abdomen but no colic. There has been no nausea and vomiting.

Physical examination. The patient has a temperature of 103° but does not look sick. Her voice is deep and of a masculine quality. Her build is that of a man. There is no excess of hair on the face, but she explains that she has recently had this pulled out. The chest and abdomen are thickly covered with coarse hair. The pubes and hips are those of a man. The skin is coarse and dry and of a dull red color. Blood pressure 130/90. Heart and lungs not abnormal. Abdominal examination shows a large tumor, which does not move with respiration, filling the right side of the abdomen. Pressure on this mass does not cause pain except at its left border where it becomes very painful. There is some spasm of the muscles on the left side of the abdomen.

Vaginal examination shows a clitoris 4 cm. long which has the appearance of a penis. The labia are rather large. Bimanual examination shows a normal vagina and uterus in good position.

A catheter specimen of urine showed many leucocytes and motile bacilli, which culture later proved to be colon.

Cystoscopic examination showed slight redness of the bladder mucosa. Both ureters are in normal position. Both ureters were catheterized with ease and there was a free flow of turbid urine from each side. Examination of this urine showed little difference there being many leucocytes and colon bacilli in each.

Left pyelogram showed a normal looking left kidney in normal position. The next day a right pyelogram was done. The right ureter soon after leaving the bladder crossed over to the left side and the pyelogram showed the pelvis and calyces of this kidney just below the left kidney. The calyces were pointed downward and outward. My assumption was that I was dealing with a unilateral fused kidney. The mass was hard to explain unless it was a much dilated pole of one kidney.

As the patient did not improve under rest in bed and forced fluids and alkalies I operated. My idea was merely to cut down and drain what I thought must be a pyonephrotic sac.

The incision was a right oblique lumbar kidney incision. This

brought me down upon a large fluctuant feeling mass which was covered with large veins such as one sees in hypernephroma. The mass was tense and felt as though it contained fluid. Thinking this to be the case I punctured it with a knife. There was a gush of bright red blood and I was obliged to pack to stop the bleeding. I was still at a loss

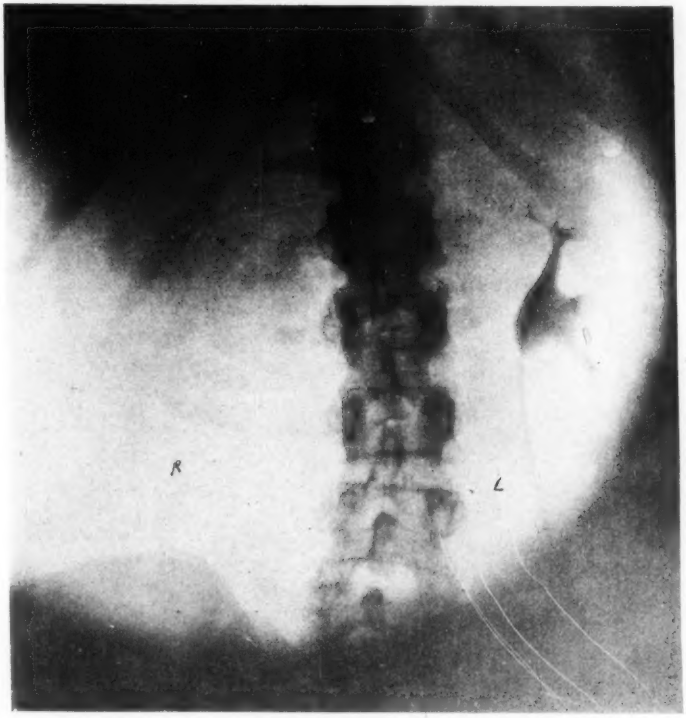


FIG. A. PYELOGRAM OF LEFT KIDNEY IN NORMAL POSITION

to explain this tumor. I then carefully freed this mass, watching all the time for a ureter or for some connection with the kidney mass on the left. The mass was finally freed except for a pedicle of large vessels which was clamped, cut and tied. On removing the mass the upper pole was seen covered with normal looking adrenal tissue. There was also some of this tissue in the upper part of the wound.

The tumor was sent to Dr. Lawrence Smith of the Harvard Medical School for examination.

The patient made an uneventful convalesence. The temperature rapidly came down to normal and the urine at the time she left the hospital, three weeks after operation, contained only a few pus cells

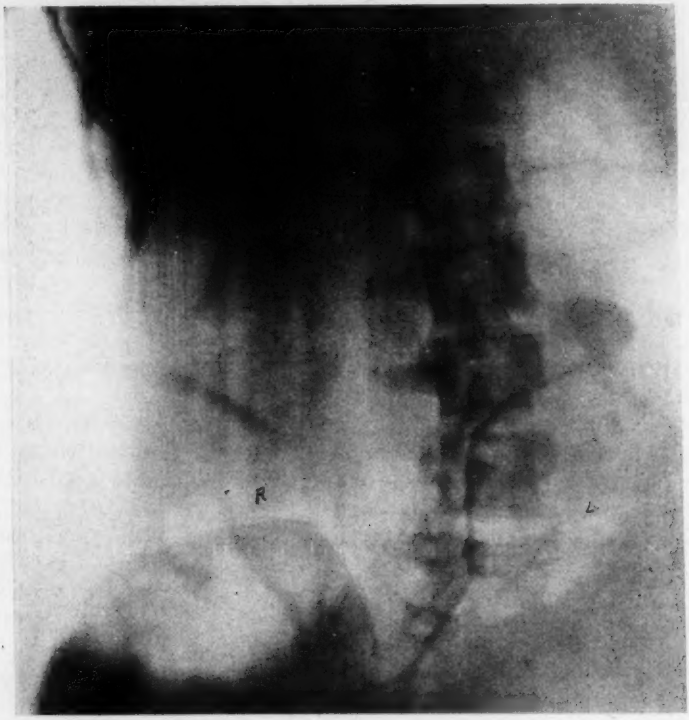


FIG. B. PYELOGRAM OF RIGHT KIDNEY LYING ON LEFT SIDE WITH CALYCES POINTED DOWN

and a few colon bacilli. Of course, what she had was an acute pyelonephritis and her operation had nothing to do with her recovery from fever.

The day before she left the hospital I did double pyelograms and much to my surprise both kidneys were in normal position. The

right kidney had returned to its bed and it had rotated back so that its calyces instead of pointing down and out on the left pointed outward on the right.

Three weeks after leaving the hospital she had a normal menstrual period, the first in nine years.

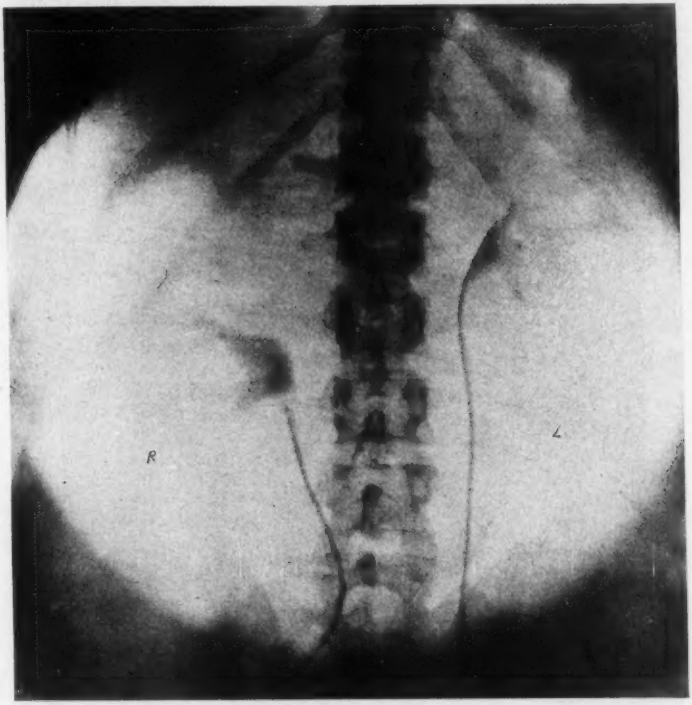


FIG. C. PYELOGRAM AFTER OPERATION SHOWING BOTH KIDNEYS IN NORMAL POSITION

She also has noticed a decided change in her skin. It has lost its dull red color and seems softer. Her last visit to my office was February 1, 1927. It will be interesting to note whether the hair on the body and face will cease growing.

Pathological report. Specimen consists of an ovoid tumor measuring 17 by 12 by 10 cm. It is deep purplish red in color, and on casual

inspection suggests an acute splenic tumor. There is a narrow band representing a pedicle in which the blood supply is found. This extends the entire length of the specimen. There is no suggestion, however, of a hilus. There is a definite capsule which for the most part is rather slatey blue gray in color, and shows variation in its thickness. There is nothing particularly characteristic about the external appearance of

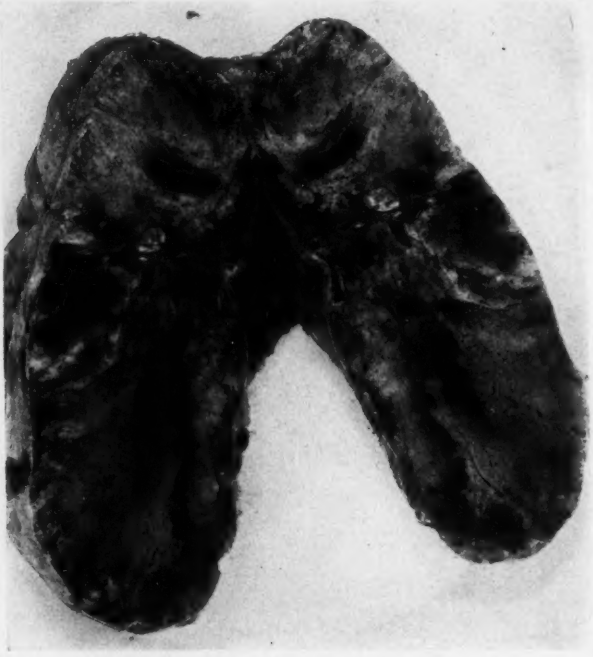
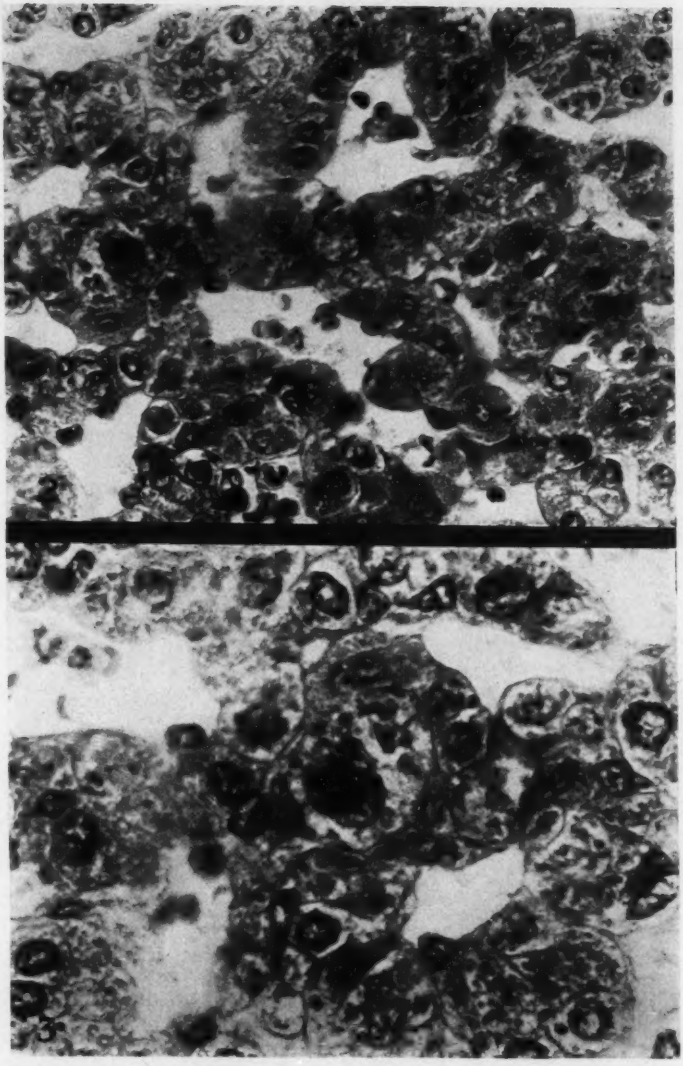


FIG. 1. GROSS PHOTOGRAPH OF TUMOR IN CROSS SECTION
Note hemorrhagic areas and well defined capsule

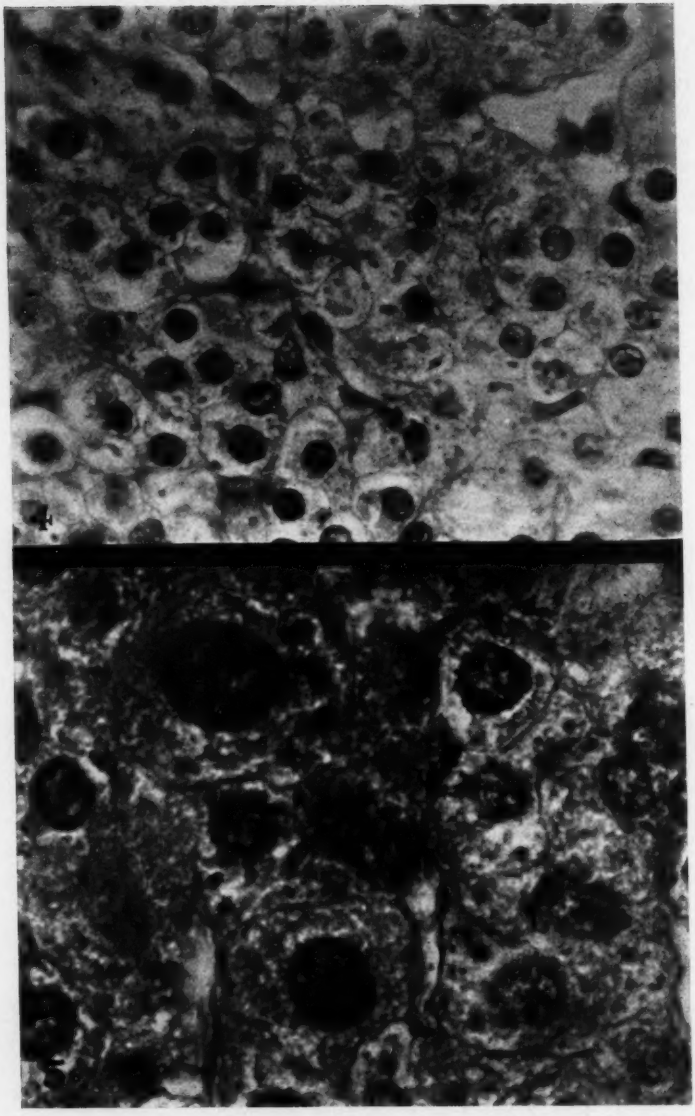
the tumor to identify it except that along the line of attachment there is a small yellowish bit of tissue which resembles normal adrenal cortex in its general outline. This merges directly with the main mass of the tumor (fig. 1).

On section, the specimen is beefy red in color, it is exceedingly hemorrhagic and loses approximately a quarter of its volume with the out-



FIGS. 2 AND 3. LOW AND HIGH PHOTOMICROGRAPHS

Illustrates the trabecular arrangement of the cells with the formation of atypical giant cells. Note also the vacuolated appearance of the cytoplasm.



FIGS. 4 AND 5. LOW AND HIGH POWER PHOTOMICROGRAPHS OF TUMOR
Shows the massive sheet-like growth of the cells in some areas

pouring of blood. This specimen, after this loss of blood, presents numerous yellowish areas, particularly around the periphery. Centrally, the entire tumor seems to be made up of large vascular spaces outlined by a grayish trabeculae stroma, suggesting fibrous tissue. In the peripheral portion of the tumor, which shows this yellowish color, numerous focal areas of hemorrhage are seen. Nothing is noted which is particularly characteristic diagnostically, although the yellowish color of the cortical portion of the tumor calls to mind the possibility of an adrenal tumor.

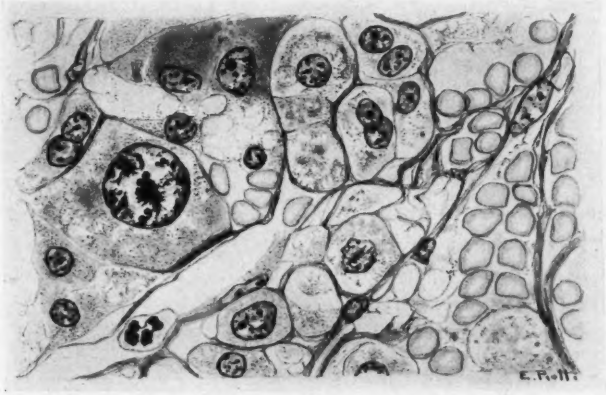


FIG. 6. HIGH POWER CAMERA LUCIDA DRAWING. ATYPICAL GIANT CELL AS COMPARED TO NORMAL CELLS

Note also extreme vasularity of tumor. Zeiss 2 mm. obj. No. 4 ocular.

Microscopically. Sections taken through various portions of the tumor present the typical histology of an adrenal adenoma of cortical cell origin. It shows extensive cystic degeneration and hemorrhage centrally. The capsule is well defined and shows no infiltration by tumor cells, although a few lymphocytes and other inflammatory cells are noted. The cortical portion of the tumor consists of cells which tend to be polyhedral in outline and to be arranged for the most part as in the zona fasiculata of the adrenal cortex (figs. 2 and 3). In places the cells are more solidly massed (figs. 4 and 5) almost as syncytial sheets of epithelium, although even here, between the cells, blood vessels and a delicate connective tissue stroma can be made out. For the most

part, the cells have the delicate finely vacuolated appearance which we associate with characteristic adrenal cortical cells. There is very little coarse vacuolization. The nuclei tend for the most part to be fairly uniform in size and have the characteristic arrangement of the chromatin as seen in the normal adrenal. The nuclei are found, with a well defined cell membrane and nucleolus. Rare mitotic figures are encountered, and here and there throughout the specimen extremely large giant nucleated cells are found with very dense staining nuclei five to six times the normal average size (fig. 6). This enlargement appears to be at times at the expense of the cytoplasm, which is relatively re-

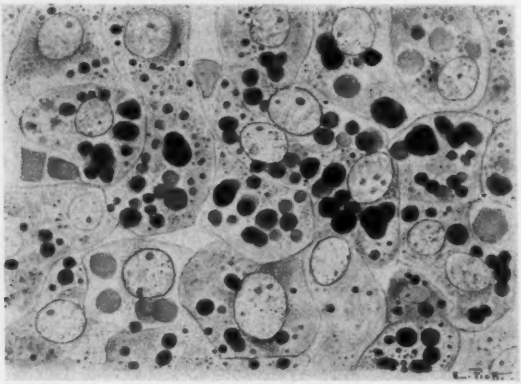


FIG. 7. HIGH POWER CAMERA LUCIDA DRAWING. NILE BLUE SULPHATE STAIN

Illustrates the distribution of the lipochrome and fat droplets within the cells.

duced in amount. Toward the central portion of the tumor the cells are much less regularly arranged, appearing to outline large vascular channels. Their general appearance is much the same as in the cortical portion of the tumor except they show some tendency toward spindle form, occurring parallelly between the sinus-like venous channels.

Special stains are utilized in studying the specimen, particularly various fat stains. These confirm the opinion obtained from the routine Haematoxylin and Eosin, and Eosin, Methylene-blue sections. There is very little neutral fat present, which corresponds apparently to the coarse vacuoles noted in the Haematoxylin and Eosin preparations.

Stained by Nile Blue sulphate, the preponderance of the droplets is found to be definitely of lipochrome origin, as they take the blue dye intensively (fig. 7). These appear doubly refractive as seen by the polariscope. Silver nitrate impregnation does not show the presence of any epinephrin. These gross and microscopic characteristics are brought out by the appended illustrations.

DISCUSSION

Physiological changes associated with variation in certain of the ductless glands have been noted since Hippocrates. These have been chiefly related to the thyroid and pituitary. More recently, attention has been called to the part which the suprarenal capsule plays in this field. Since the publication of a paper by Bulloch and Sequeira (3) in 1905, a very considerable literature has accumulated on the relation of the suprarenal capsules to sex. Among the most notable of these contributions have been those of Glynn (9), Gallais (8), Krabbé (13), Holmes (11), Collett (4), Scabell (22), Apert (1), Rolleston (21), and Fawcett, Hadfield and Phillips (6).

Embryology. As is well known, the suprarenal capsule in man arises from two distinct embryologic structures; the cortex being mesothelial in origin and arising from the Wolffian Ridge, in common with the ovary and testes; the medulla from the sympathetic nervous system. During foetal life the cortex is relatively very much thicker than it appears in adult life, and is termed the "foetal cortex." This is replaced shortly after birth by the adult type of cortical cells, which in general are rather smaller.

Physiology. The physiology of the adrenal is still sub judice. It is generally conceded that one of the principal functions of the gland is related to the production of adrenalin. This is considered largely a function of the medulla, but the cortex is thought to assist in its production by some very poorly understood catalytic action. In the second place, the adrenal acts as a detoxifying agent (Porak (20)). In the third place, it is intimately associated with cholesterin metabolism. (Porak, loc. cit.) (Yovanovitch (28)). And finally, it obviously is connected with growth and development, particularly of the sex organs. This apparently is

entirely a function of the cortex as seen by experimental work on the removal of the inter-renal bodies in elasmobranch fishes. Further evidence of the intimate relationship between the adrenal and the other ductless glands is seen by the experimental work of Marine (16) and Jaffé (12). Among clinical reports of such inter-relationship may be cited the case of Long and Gray (15) of a man forty-five years old with acromegaly, who at autopsy showed a tumor of the right adrenal cortex and marked hyperplastic changes in the left adrenal, with giant cells, mitotic figures and polyhedral hypernephromatic cells. In addition, the man had a typical pituitary adenoma of the posterior lobe, chiefly made up of acidophilic cells.

So much work has been done on the physiology of the medulla that little needs to be said in relation to the subject at hand. The numerous papers of Cannon and his associates have emphasized the importance of the medulla in the production of adrenalin and have shown the relationship of this substance to many of the physiological processes of normal life, such as the regulating effect upon blood pressure, the relationship to emotional response, etc.

Pathology. The scope of this paper does not warrant the inclusion of much other than the tumors of the adrenal. From the point of view of the pathologist, however, it is always of interest to remember that attention was first called to the adrenal by Addison in 1855, who first described the diffuse destruction of the adrenal gland by tuberculosis, giving rise to the clinical syndrome now called by his name, accompanied by low blood pressure, asthenia, and pigmentation. Aside from Addison's Disease, which we recognize as a clinical entity, but which can be produced not only by tuberculosis but by any process interfering with the normal physiology of the adrenals, there is very little recognized pathology except the changes associated with tumor formation. And, indeed, Addison's disease may be produced in turn by such tumor formation when the lesion is bilateral.

Tumors of the adrenal may arise obviously either from the medulla or from the cortex. Those arising from the medulla are always malignant. The literature, up to the publication of J. Homer Wright's paper in 1910 (29), was most confusing, as these

tumors had been variously called round celled sarcoma, lympho-sarcoma, glio-sarcoma, carcinoma, and neuroblastoma. He showed that these tumors originated from the sympathetic nervous system, and suggested the terms neuroblastoma or neurocytoma as being the most applicable. In 1912 Pick (19) reported eighteen cases and suggested the name ganglioma embryonale

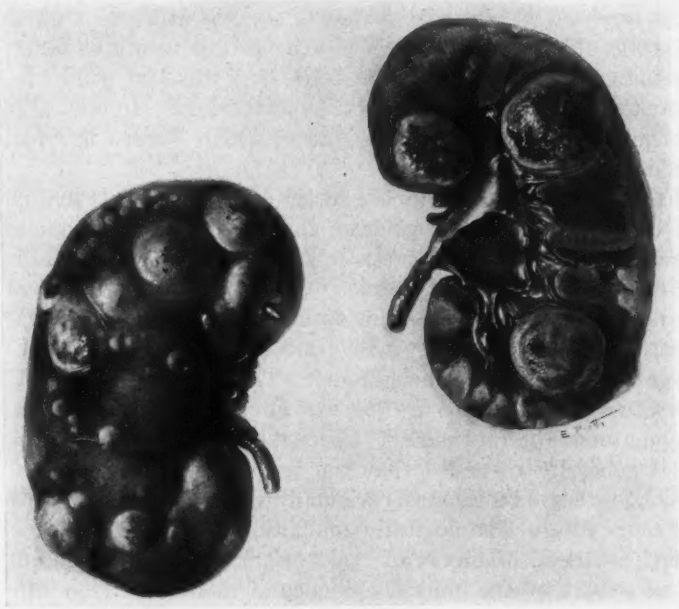


FIG. 8. KIDNEY

Illustrates the typical method of metastasis of the neuroblastoma (adrenal medulla) as seen in infants and young children.

sympathicum. Landau (14) simultaneously used the name sympathetic neuroblastoma. In 1918 Wolbach and Morse (26) published a case with some excellent photomicrographs illustrating the fibrillar structure of the cells. They reviewed the literature and confirmed the choice of nomenclature for this type of tumor as neuroblastoma sympathicum (fig. 8).

The other, and less common types of tumor, which are occasionally found originating from the medulla, may be spoken of as the ganglioneuromata and the paragangliomata (or pheochromocytomata (Pick)). We have seen but one example of the ganglioneuroma type, occurring in an infant. This is being reported by another member of the department. The latter group is made up of adult chromoffin cells. Zeckwer (29), a year ago reported a case and reviewed the literature to that date. She was able to find but twenty-five cases on record as occurring in man. According to Oppenheim (18) this last group is frequently found associated with hypertension. He was able to collect five cases of this type, four of which showed this feature definitely.

The tumors arising from the cortex are less regularly malignant in character. They range from the tiny pseudo-adenomata or accessory bits of cortical tissue in the fatty capsule of the adrenal to the large malignant tumors clinically usually described as hypernephromata. These are similar in a general sort of way to the tumors of the kidney which are thought to arise from embryonic inclusions of the adrenal. These latter were first described by Grawitz (10) in 1884, who gave them the name "struma lipomatodes aberrata renis." Since the publication of that paper it is generally conceded that the true adrenal rest tumors are much less common than was originally thought, as many of them on more careful histological examination have had to be reclassified as adenocarcinoma of renal origin. This is borne out to some extent by the clinical evidence of cases with true adrenal cortex tumors, such as the case reported here.

It is the purpose of this paper to discuss particularly the tumors of the cortex in relation to the extraordinary changes in the secondary sex development. The recent paper by Fawcett, et al. (loc. cit.) discusses the relationship of the various ductless glands to the secondary sex characteristics. They feel that the weight of evidence suggests that ordinarily sexual fate is determined at the time of fertilization. This is due to the number and arrangement of the chromosomes in the conjugation nucleus of the ovum. This may, however, be altered during

embryonic life or even subsequently, by alterations in the ductless glands, including the pituitary, thyroid, and adrenal cortex, as well as by the gonads. It has been shown statistically that over 15 per cent of pseudohermaphrodites have a bilateral suprarenal cortex hyperplasia.

Gallais (8), in his Paris thesis, classifies these cases into four major groups, based largely on the age of the appearance of symptoms. He feel that there is a definite syndrome to which he has given the name le syndrome génito-surrénal. This is characterized by a group of dystrophic symptoms tending to show precocious maturity and a differentiation toward the masculine type, associated with hyperplasia or tumor of the adrenal cortex. This occurs almost always in women. His classification is as follows:

First, the congenital group of true adrenal pseudohermaphroditism.

Second, the pre-puberty group, to which the term adrenal virilism has been applied. This is the commonest form of the condition.

Third, the adult group, which he describes as the menstrual form.

There is a fourth, less important group, occurring at the menopause, to which he gives the term obstetrical form.

Krabbé (13), in his paper, states that he does not believe that the evidence is conclusive that the adrenal cortex has an internal secretion regulating masculinity. He asserts that the ovary is originally hermaphroditic; its cortical portion being female, and its medullary portion male. Ordinarily the medullary portion remains rudimentary, but it is closely related in origin to the adrenal cortex from the Wolffian ridge, and Krabbé believes that these tumors of the adrenal really represent displaced ovarian medullary cell rests. He makes the further observation that of the seventeen cases which he was able to find in the literature, of adrenal tumors associated with apparent praecox puberty, only four occurred in boys. The condition is not a true praecox, as in only one of the girls was actual praecox present with evidence of menstruation. In the case of the boys, however, it is more likely to result in a true praecox. He feels that the term adrenal

hirsutism is a better one than the term virilism, ordinarily given to these cases.

Apert (1) has collected thirty-five cases with necropsy. He agrees essentially with Gallais in the division of the cases on a basis of age, making, however, an additional sub-division of the first period into an embryonal and a foetal period. He uses the term hyperepinephry. In contrast to this is the small group of cases to which the terms progeris (Gilford) and nanisme senile (Variot) have been applied. He proposes the name hypoepinephry for this group as a contrasting term, as is customary in speaking of other ductless glands. This group consists of cases of premature senility, which may even appear in early childhood, and is apparently the result of an almost negligible adrenal gland function. In the milder forms of hypoepinephry we see many cases of disturbed endocrine balance with low blood pressure and a general loss of muscular tone. It is an extremely difficult group to recognize definitely as being of endocrine origin, but in a small number of cases there seems to be not only clinical but some scientific basis for this assumption.

Feinblatt (7) reported a case recently in a young Jewish woman of thirty-two who showed progressive emaciation and virilism. The case at autopsy showed an extension of the primary tumor into the vena cava. Histologically it was a typical hypernephroma.

Rolleston (21), in his consideration of the adrenal tumors, goes into very complete discussion of the clinical findings and the anatomical changes associated particularly with the cortical tumors. As he states, in adult life these tumors are usually unilateral. After puberty and before the menopause, women with cortical hypernephromata show excessive growth of hair, amenorrhea, and obesity. The hypertrichosis is of the masculine type, thus differing from the physiological excess of hair sometimes seen in pregnancy. The obesity may be followed by remarkable red "liniae distensae" and the mental attitude may change to a masculine standpoint. Mauclaire (17) reports a tumor of the right adrenal cortex which had been present for six years. It was a benign tumor removed surgically, with the restoration of menses in two months.

This latter case, together with Collett's case of the genito-suprarenal syndrome in a girl one and a half years of age, and Gordon Holmes' case in a young woman of twenty-four years, are the only three cases which have been followed long enough after operation to know what we may expect. In all of these cases the secondary sex characteristics have reverted to essentially normal, although Collett's case still showed some persistence of the anatomical changes of the genitalia two and a half years post-operatively.

Histo-pathology. The pathology of the adrenal tumors is fairly well recognized today. Of the group of tumors arising from the medulla, the most common tumor is the simple neuroblastoma, which tends to show nodular masses varying in size from 0.5 cm. to large tumors 5 or 6 cm. in diameter. These are grayish white in color, extremely friable in consistency. They do not lend themselves readily to frozen section for diagnosis. These medullary tumors may be divided clinically into two major groups, as was indicated by Tileston and Wolbach (23) in their paper, i.e., the Pepper type, in which the characteristic picture is an extension into the kidneys and especially into the liver; and second, into the Hutchinson type, occurring almost invariably in infants or young children, with secondary metastases into the skull, especially about the orbit. Frew, quoted by Rolleston (21), states that this apparent discrepancy in metastases depends on the origin of the primary tumor. In a series of fifty-one cases he showed that the cranial metastases were much more prone to occur when the primary growth was in the left adrenal. Interestingly enough, also, the orbital metastases tend to occur on the same side as the primary tumor, but this apparently is merely coincidental.

In the cortical tumors, there is a general tendency for the cells to be arranged much as in the zona reticularis of the adrenal cortex. Very frequently large atypical giant cells are found, and in places the cells tend to be arranged in massive sheets. The typical cell is polyhedral rather than spindle, but in several of the reported cases they assume the spindle form. Collett (loc. cit.) in his case, reports the cells of the tumor as containing

large polymorphous giant cells with one to ten nuclei. Bulloch and Sequeira (loc. cit.), in their case, showed a tumor with metastases in the liver, lungs, and right kidney. Their tumor weighed three pounds, one ounce, and was extremely vascular, with large yellow areas of degeneration. Scabell (22) reports a case in a girl of thirteen, with a large tumor of the left adrenal, measuring 30 by 15 by 10 cm. This was extremely vascular. This showed no evidence of metastases, and is quite comparable to the case reported here except in respect to the age group. He reported another case in an apparent congenital hermaphrodite, in which no definite tumor was found, but a definite bilateral adrenal cortical hyperplasia. He gives an excellent review of the literature, and a table of cases up to 1924.

Glynn (9), in analyzing the histology of these tumors, says that they tend to resemble the adrenal cortex, having round, oval or polyhedral cells which are never cylindrical in form. The cytoplasm tends to be foamy or finely vacuolated, and is never dropsical. The nuclei are round or oval. Most of the tumors contain multinucleated giant cells. He feels that the cells, being arranged in columns, abutting on thin-walled blood vessels, tend to suggest alveoli, and resemble the zona fasiculata of the normal adrenal. In a later paper, he states that the histology is quiet variable and may revert to the primitive cell type, which, being mesothelial, tends to suggest a sarcomatous degeneration. In addition, he found frequently a perithelial arrangement which he felt was the result of necrosis, and was not able to find any definite lumina in the nine cases of proven adrenal hypernephromata.

Wilmore and Douglas (25) report a case of a suprarenal tumor in a man of thirty-one, with a history of symptoms for about fifteen months before death. They found a cortical tumor the size of a man's fist. There were no marked changes of the secondary sex characteristics. They note that the microscopic pathology showed a diffuse generalized degeneration of the reticulo-endothelial system. The material was sixteen hours post mortem, however, and the changes which they describe seem possibly associated with this fact rather than as a causative agency in the production of the tumor, as they suggest.

Weber (24) reports a case of a man twenty-seven years of age with an adrenal cortical tumor, who showed evidence of bilateral gynaeco-mastia, and cites another similar case of Mathias' with identical pathology. He sounds a note of warning that the adrenal cortex is not necessarily restricted in its hormonic control of the masculine secondary sex characteristics, but may play a part in the establishment of extraordinary secondary sex changes in males as well. He also reports a case of a woman twenty-eight with cutaneous striae, purpura, high blood pressure, amenorrhea, and obesity. This clinical syndrome he states is that usually associated with cortical tumors of the adrenals, but in this instance none were present, and he suggests the possibility that there is a vicious cycle with the formation of the adenoma as a result of some other stimulating morphogenetic and hormonic factor.

Bland-Sutton (2), in reporting a remarkable tumor occurring in a doctor of forty-five, found a tumor involving both adrenals, which was extremely vascular and had the histology of the zona fasiculata. This showed delayed metastases to the humerus and subsequent metastasis, six years later, to the spine. There were no changes noted in this instance in relation to secondary sex characteristics.

Downs and Knox (5), in reporting a case of hypernephroma of the ovary, found a tumor of typical histology, so closely related to the ovary that they felt it was of ovarian origin, but there seemed to be a definite line of demarcation between the tumor and the flattened ovarian parenchyma. In going over the literature, they found only eleven other cases, with only one other occurring in childhood and influencing the secondary sex characteristics.

There seems to be no particular purpose in further retabulating these cases, as they have been very adequately discussed by the various authors cited. Of these, perhaps Collett, Scabell, and Rolleston offer the most complete bibliographies.

This case seems to represent the 19th authentic instance of a cortical adrenal tumor occurring in a female, with the typical changes in the secondary sex characteristics noted in relation to

these tumors. It is apparently only the third or fourth case which has occurred in Gallais' third group, the adult during the child-bearing period, and also is one of the few cases on record where the diagnosis has been confirmed by surgical intervention and a cure effected with the reversion to the feminine habitus.

It is a field so fertile for speculation that one is hardly warranted in making but the most trite generalizations. While there seems to be no doubt that ordinarily the secondary sex characteristics are regulated by the interstitial glands of the gonads, yet it appears equally certain, on the basis of accumulated clinical and pathological evidence, that related functions may be assumed by the adrenal cortex. It is one of these difficult problems from the point of view of the experimentalist, as adrenal cortex hyperplasia is not something which can be induced at will. With such definite evidence of the genito-adrenal syndrome as has accumulated over the past two decades, it seems unnecessary to try to explain away such conclusive evidence by such an ingenious method as Krabbé (loc. cit.) presents. In this connection it is interesting to consider the difference in the clinical picture in individuals presenting more or less comparable tumors. A case in point is a circumscribed tumor occurring in the left kidney of a negress thirty years of age. This case report is in press, and it is through the courtesy of Dr. James S. Stone and Dr. Joseph Merriam that I am able to refer to it. In this instance a large tumor the size of a grape-fruit was removed from the mid-sector of the kidney. Histologically, it has to be considered as a simple adenoma presenting the characteristic features of the Grawitz tumor. The specimen was submitted to several pathologists, who concurred in the diagnosis of adrenal adenoma. The chief interest lies in the fact that in this case no changes of the secondary sex characteristics were apparent. Several explanative hypotheses are possible; of which perhaps the two following are the more likely. In the first place, the fact that this tumor occurs in an individual in adult life may very materially alter its effect on masculinity. It is quite obvious that once the complete development of the physical being is reached, alterations of sex are much less readily accomplished by excess of any one ductless gland

secretion than during the developmental pre-puberty period. Such cases as the one cited in this paper probably represent much less stable individuals or perhaps the tumor may have been present in an inactive stage for a long period of time before developing its maximum effect, or the tumor produced so large a quantity of the adrenal cortical hormone that this effect was produced. In the second place, another interesting speculative possibility would be the fact that while these tumors histologically appeared to be identical, yet there were inherent differences functionally, as well possibly as genetically, which would readily account for the lack of development of virilism in the one case, and its development in the other. Similarly, the essential difference between the true adrenal tumors and the so-called "hypernephromata" of the kidney, is again assailed with this additional bit of evidence to separate the two types of tumor, which, while morphologically apparently identical, differ widely functionally. This may in some instances be of value as a differential criterion in the diagnosis of these tumors. Again, the inter-relationship of the various ductless glands cannot be entirely disregarded, and the intimate relationship between the adrenal and the thyroid which Jaffé has demonstrated so satisfactorily in his experimental work, may be of real significance in respect to such cases. Just as in cases of pituitary disease, we find marked differences in the clinical picture occurring during infancy or childhood, in the development of gigantism, while in adult life, hyper-function leads to the clinical picture of acromegaly.

SUMMARY AND CONCLUSIONS

A discussion of the pathology of the supra-renal capsule is presented, with especial reference to the two major types of tumor, the medullary neuroblastoma, and the cortical cell tumor, which may occur either as a benign adenoma or as a malignant true hypernephroma.

A brief note on the embrylogy of the adrenal is included in order to understand the difference in types of the tumors occurring in this situation.

A short treatise of the literature relating to adrenal virilism and the tumors of the adrenal cortex is given.

A case report, with its related histo-pathology, is taken up in some detail, illustrating the intimate relationship of this type of tumor to pseudo-hermaphroditism in the female.

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THROMBOSIS OF THE RENAL ARTERY WITH TOTAL OCCLUSION

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A review of the literature shows that thrombosis of the renal artery is a very rarely reported entity.

The pathology of this condition has been well described by Virchow, Litten, Rokitansky, Ribbert, Cohnheim and others, while the clinical manifestations appear to have received scanty attention. This may be accounted for by the limited number of cases and the fact that the diagnosis was made at autopsy. In only one case was a diagnosis made *intra vitam*.

Having had the opportunity of personally observing a case, I think it desirable to report it in detail, first, because this condition is another etiological factor in the production of renal colic, and second, because the observations may help to shed some light in the recognition and differentiation of thrombosis of the renal artery.

CASE HISTORY

H. A., white male, aged twenty-nine, married, entered the hospital on the morning of January 17, 1927, complaining of pain over the right kidney. The onset was sudden and severe five days before entrance. The pain was most acute over the right kidney but radiated across the back and down the right thigh. This attack lasted only five minutes. On January 16, the day before entrance, he had a constant pain in the region of the right kidney. This pain was dull and aching in character and was not referred. At no time had there been any hematuria, dysuria or pyuria, but some difficulty was experienced in starting to urinate. Since the onset he had been constipated.

The past and family histories were essentially negative.

Physical examination revealed a fairly well-nourished and well-developed white male who appeared acutely ill and in some distress. Temperature was 99, pulse 80 and respirations 20. Examination was

essentially negative except for slight rigidity of the abdominal muscles on the right side and tenderness on pressure over the right kidney. The kidney was not palpable, neither were there any other palpable masses.

Shortly after his entrance the patient was sent to the x-ray laboratory for both an anteroposterior and a lateral view of the genito-urinary tract to determine whether or not a renal stone was present. The roentgenologist reported the picture negative for stones but stated that the right kidney was somewhat lower than normal. Upon returning from the x-ray laboratory the patient was in such violent pain that morphin sulphate, grains one-quarter, was necessary to relieve him.

Blood count on entrance showed 3,610,000 red cells; 13,000 white cells; 60 per cent hemoglobin. Differential count showed 81 per cent polymorphonuclears, 15 per cent small lymphocytes, 4 per cent large lymphocytes. Blood pressure 35/90.

The total amount of urine voided between 11 a. m. January 17 and 6 a. m. January 18 was 425 cc., the specific gravity of which was 1020, reaction acid, no sugar, albumen 1+, and an occasional hyaline cast and leucocyte.

During the first twenty-four hours the patient was given a hot soapsuds enema one-quarter grain of morphin, and a soft diet. Food was not well tolerated and each time he attempted to eat he vomited immediately.

On January 18 cystoscopy was attempted but was unsuccessful because of a urethral stricture; a small metal catheter was introduced into the bladder with difficulty. At 10 a. m., the time the cystoscopy was attempted, his temperature was 100°, respiration 22, and pulse 84. At 4 p. m. the same day temperature was 104.8°, pulse 108 and respiration 34. At 6. p. m. temperature had dropped to 101.4, following a tepid sponge bath. During the night he perspired profusely, was extremely restless, and complained of pain in the lower abdomen.

On January 19 he voided 530 cc. of urine which contained 1+ albumen, many red blood cells, but no sugar.

On January 20 a small sound was passed with the idea of dilating the stricture. This attempt was followed by a high fever and rapid pulse as on the day before.

During the evening he said he felt better. He was resting quietly and slept the greater part of the night. On January 20, 520 cc. of urine was voided with the same laboratory findings as on the previous day.

January 21 the patient awakened after a good night's sleep but complained of feeling tired. He was apparently quite comfortable throughout the entire day. Temperature ranged between 99.2 and 100.8, pulse 80 to 108, and respiration 20 to 28. There was no change in the laboratory findings.

January 22 he awakened in the morning complaining of a dull pain in the right chest. Temperature was 102.4, pulse 102, and respiration 26. He was expectorating a thick mucus which was occasionally blood tinged. During the day he had several chills lasting from two and one-half to five minutes. Examination of the chest was essentially negative except for an occasional râle at the right base posteriorly. During the day the patient perspired profusely. Temperature ranged between 102.8° and 105°, pulse 102 to 120, and respiration 26 to 30. He was given 1200 cc. normal saline solution subcutaneously and sodium bicarbonate, grains ten, every four hours by mouth. Fluids by mouth were also pushed to the limit and frequent sponge baths were given. The twenty-four hour specimen of urine amounted to 785 cc. with no change in the laboratory findings from those previously cited.

On January 23 he said he felt drowsy and complained of soreness in his finger tips, shortness of breath and nausea. During the day he perspired profusely and also vomited several times. Stools were watery and contained undigested food particles. Temperature ranged between 105 and 102. Blood count showed 21,300 leucocytes. During the day 560 cc. of urine were voided which contained 1+ albumen, many red blood cells, few leucocytes and epithelial cells, but no sugar.

On the morning of January 24, 1927, the patient was complaining of abdominal pain, feeling of weakness and nausea. Examination revealed the abdomen to be somewhat rigid with more or less generalized tenderness. Upon the skin of the abdomen were many small reddish colored spots which were suggestive of "rose spots." Temperature ranged between 102 and 104, pulse 96 to 118, and respiration 24 to 34. Patient was so weak that to take his food exhausted him. Specimens of stool and urine were sent to the laboratory and were reported negative for typhoid and paratyphoid organisms. The Widal test was also negative. White blood count at this time was 37,600. During the twenty-four hours 495 cc. of urine were voided which contained only a trace of albumen. He perspired profusely during entire day and night.

On the morning of January 25 the patient seemed in a semi-stuporous condition; temperature 104, pulse 108, and respiration 26. He was given 500 cc. of 10 per cent glucose solution intravenously by the drop

method, following which he had several involuntary passages of urine. A suprapubic cystotomy was decided upon and was done under local anesthesia. Following the operation he was given glucose 6 per cent and 2 per cent bicarbonate of soda as proctoclysis. Temperature was 102, pulse 108, and respiration 26. Drainage from the bladder was free. During the night he rested fairly well, sleeping at intervals, but continued to perspire profusely.

The following morning, January 26, he was given two ampoules of digifolin and 1000 cc. of normal salt solution subcutaneously. He was becoming progressively weaker. Temperature ranged between 102 and 105. Pulse was weak and rapid, 100 to 160. Frequent sponge baths were given in an effort to reduce fever but with no results. At 10 p.m. 500 cc. of citrated blood were given intravenously, following which the temperature rose from 103° to 106°, pulse from 100 to 140, and the patient had a severe chill lasting twenty minutes. Later he became exceedingly restless, talked at random, and began to have involuntary bowel movements.

On the morning of January 27 he was still delirious, talking and moaning constantly. He was given 1000 cc. of normal saline solution subcutaneously and immediately after he had a violent attack of vomiting and then began to hiccough. There were frequent involuntary bowel movements.

The following day he hiccoughed incessantly. Benzyl benzoate, glycerin, sugar and chloroform were used in an effort to stop the hiccough but without success. He appeared very drowsy and had to be aroused in order to take nourishment; at this time he found it exceedingly difficult to swallow. During the afternoon respiration became labored. Temperature ranged between 102° and 104° and pulse from 108 to 158. The abdomen became distended. Subcutaneous salt solution and digifolin were given but respiration continued to be labored, the pulse became imperceptible, and the patient expired. A postmortem was obtained with the following findings:

Anatomical diagnosis. Vegetative endocarditis of the aortic cusps; embolic occluding thrombosis of the right renal artery; almost complete infarction of the right kidney; multiple infarcts of the left kidney and spleen; multiple petechiae of the skin of the trunk and arms; fibrinopurulent peritonitis; stricture of urethra; recent suprapubic cystotomy wound; bronchopneumonia of the lower lobe of the left lung; suppurative tracheobronchitis; marked edema and passive congestion of both marked cloudy swelling of all viscera; petechial hemorrhages of intes-

tinal mucosa; petechial hemorrhages and trabeculation of the lining of the urinary bladder; hypertrophy of the left ventricle; right hydrothorax; left obliterative pleuritis; acute hyperplasia of mesenteric lymph nodes.

Detailed description of heart and kidney. The heart is enlarged (weight 410 grams). The apex is made up entirely of left ventricle. Moderate subepicardial fat deposits are present. There are no changes in the lining of the right heart. The tricuspid valve is 12.5 cm. in circumference, the pulmonary 7 cm. There is an epicardial scar on the posterior surface of the left ventricle. The circumference of the mitral valve is 12.5 cm. The margins of the leaflets are slightly thickened. The papillary muscles are shortened and somewhat scarred. There are no vegetations on the mitral valve. On the aortic surfaces of two aortic cusps are masses of heaped reddish grey vegetations, 2 to 3 cm. across and 0.5 cm. thick. They are close to the margin of the cusps and are easily broken. The lining of the aorta is smooth except for small yellow patches of atheromatous change.

The combined weight of both kidneys is 320 grams. The right renal artery is not patent, beginning about 4 cm. distal to the origin of the artery. It is plugged with a reddish brown clot that is adherent to the intima of the vessel. The capsule of the kidney strips readily leaving a dull yellow surface except for a narrow rim of red brown at the upper pole. This extensive necrotic change involves cortex and medulla alike, obliterating the normal markings. The lining of pelvis and ureter is smooth. The left renal artery is patent. When the capsule of the left kidney is stripped away there are seven sharply circumscribed yellow areas, irregular in outline, and which vary in diameter from 1 to 3 cm. These are pyramidal-shaped fresh infarcts which extend for varying depths into the parenchyma. The lining of the left pelvis and ureter is smooth.

Cause of death. Myocarditis and uremia.

RÉSUMÉ

In this case we are dealing with a relatively young individual who, until the onset of the present attack, was apparently in good health. Neither his history nor his physical examination revealed any focus of infection that could be considered as an etiological factor in the case. The points of special interest are: (1) Sudden onset of pain which was most severe at its onset and gradually subsided until it was a more or less continuous, dull

ache. (2) Pain which at first was referred down the right thigh. (3) Persistence of nausea and vomiting. (4) Constipation alternating with diarrhea. (5) Acute suppression of urine with no laboratory findings especially significant of renal disturbance. The red blood cells reported were most likely due to trauma during urethral instrumentation. (6) The "septic type" of temperature curve which in this case was especially confusing because it was thought that the fever was due to urethral instrumentation. (7) Absence of marked uremic symptoms. (8) Essentially negative physical findings.

REVIEW OF THE LITERATURE

I was able to collect thirteen cases of thrombosis of the renal artery.

The first case reported in the English language was one by Halperin, of Chicago, some eighteen years ago. A brief résumé of these thirteen cases follows.

Case I (Traube). Male, eighteen years old, who had suffered from aortic insufficiency and hypertrophy of both ventricles, was awakened at 1 a.m. with acute pain in the region of the right kidney. Pain radiated to the right thigh. There was some suppression of urine but urinalysis showed neither albumen nor blood. Vomiting occurred followed by collapse, restlessness and air hunger. Death nine days after onset.

Autopsy findings. Warty vegetations on semilunar valves; infarct in spleen; many infarcts in both kidneys.

Case II (Bartels). Boy, eight years old, suddenly developed a pain in the region of the spleen following a tracheotomy. Several days later he developed pain in left thigh followed by paralysis of the limb. There were no urinary symptoms. Death occurred four days after onset.

Autopsy findings. Large splenic infarct; large infarct left kidney; thrombosis of left renal artery and branches; no endocarditis.

Case III (Yuhel Renoy). Girl, sixteen years old, while recovering from scarlet fever developed pain on both sides in the lumbar region. There was no fever. She was catheterized daily without results. She died six days later of total anuria but without uremic symptoms.

Autopsy findings. No heart lesion; necrosis of both kidneys; multiple emboli in renal arteries and glomerular tufts.

Case IV (Von Jurgenson). Woman, twenty-seven years old, with a double mitral lesion, had sudden pain over the right kidney accompanied by marked albuminuria but no blood.

Autopsy findings. Endocarditis; infarction of spleen; right kidney almost necrosed; left kidney contained small infarct; right renal artery almost entirely blocked by thrombus.

Case V (Von Seube). Male, seventeen years old, with aortic insufficiency and recurrent attacks of arthritis, had two attacks of pain over both kidneys. Previous to each attack urine was normal; with onset urine always contained albumen and blood. Case was diagnosed as renal infarction. Patient recovered.

Case VI (R. Schmidt). Male, forty years old, with mitral insufficiency and rheumatic arthritis, suddenly developed intense pain over the right kidney. There were no urinary changes. Diagnosis was infarcted kidney.

Autopsy findings. Double mitral lesion; infarcts of right kidney; hemorrhage into capsule.

Case VII (R. Schmidt). Girl, twenty-one years old, with mitral stenosis and rheumatic arthritis, developed intense pain over both kidneys. Urine contained red blood cells and abundance of albumen. There was marked oliguria. Diagnosis made of bilateral kidney infarction.

Autopsy findings. Endocarditis; splenic infarcts; infarcts of both kidneys.

Case VIII (R. Schmidt). Male, forty-five with double mitral lesion, developed pain over both kidneys accompanied by suppression of urine. Urinalysis showed albumen, casts and red cells. Pain subsided in four days. Two days later he developed a right sided hemiplegia and died from cerebral apoplexy.

Autopsy findings. Established the correctness of the clinical diagnosis.

Case IX (George Riebold). Girl, twenty-nine years old, suffering from a mitral lesion and an old articular rheumatism, was suddenly seized with pain in the left side and some suppression of urine. Urine showed neither albumen, casts nor red cells. On the third day she developed pain in the same region on the opposite side and on the fifth day a paralysis of the right arm and leg. She died on the sixth day of respiratory paralysis.

Autopsy findings. Mitral stenosis and insufficiency; embolism of basilar artery; infarct left kidney; embolism left renal artery; several small infarcts of right kidney; splenic infarct.

Case X (Von Recklinghausen). Boy died eight days after sustaining internal injuries. There was a circular injury to the coat of the left renal artery, all the branches of the artery were thrombosed, and the kidney entirely necrosed.

Case XI (Halperin). Male, forty-four years old, with history of pain in big toe of left foot for one year. Five weeks before entrance to hospital the pain in the toe became severe. Heart was negative, as was the urine. Toes of left foot were gangrenous. Amputation was done and the patient apparently fully recovered. Eighteen months later he re-entered the hospital complaining of severe pain in both lumbar regions, accompanied by vomiting, headache and slight fever. Urine contained albumen, casts and red cells. There was suppression of urine and the pain gradually subsided. The vomiting, however, continued. Constipation was also present. He died six days later of almost complete anuria.

Autopsy findings. Infarct left kidney; renal artery and branches were thrombosed; infarct of right kidney and thrombosis of right renal artery and branches.

Case XII (Oudendal and Hulst). Woman, sixty-seven years old, complained of cough and difficulty on swallowing. She had had pleurisy at the age of 47 and had experienced pleuritic pains on coughing ever after. The difficulty on swallowing was unexplained. In January 1925 she went to a old people's home and gradually lost ground. On April 15 she called a doctor because she had been unable to urinate for two days. Upon catheterization only a few cubic centimeters of thick, chocolate colored urine were obtained. At this time the patient showed no symptoms of uremia; she was alert, with no headache, disturbed

vision or pain over the kidneys. She was only slightly nauseated. Temperature was somewhat elevated and suggested sepsis. There were petechiae over the arms, back and legs. She later became stuporous. There was an uremic odor to breath and a slight edema appeared. Bacteria and pus were present in the urine obtained by catheterization. X-ray examination revealed small kidneys, but no stones present. On April 21 a decapsulation of the left kidney was done. The patient died.

Autopsy findings. Low grade osteomyelitis of some of the ribs at the sternal junction, probably due to tuberculosis; blood clot in left ventricle which was adherent to trabeculae; generalized arteriosclerosis; abdominal aorta is sclerotic and at site of renal arteries there is an atheromatous area in which a thrombus had formed. This extends into both arteries and well up into the pelvis of the kidney. Greater part of kidneys are necrotic.

Case XIII (P. W. Aschner). The patient, a male, complained of a sudden pain in the right lower quadrant lasting three hours, which recurred two days later and again in two days. Last attack occurred three days before admission. The pain radiated to left testis, and was accompanied by frequency of urination. The left upper quadrant was rigid and tender. Patient also had a mitral stenosis. Diagnosis was made of renal infarction. Kidney function test showed good concentration, with indigocarmin secreting from both sides. Many granular casts were present in the urine. At operation two grayish-white areas were found at middle and lower poles of left kidney. A decapsulation was done and the patient recovered.

SUMMARY

In reviewing the literature it appears that this disease is most prevalent in relatively young individuals, and that it occurs most frequently in the male sex. There is usually some definite, outstanding etiological factor, the principal one seemingly being some form of heart disease. The outstanding symptoms are:

1. Sudden onset of violent pain in the renal region which may or may not be referred down the thigh or into the genitalia.

2. Urinary changes, chief among which is marked suppression or a possible complete anuria. Albumen is usually present but may be absent. There may or may not be red cells and casts.

3. Vomiting, collapse, severe headache, constipation, slight leucocytosis and slight fever.

From the cases just cited it may be seen that the condition may be either unilateral or bilateral. Of the thirteen cases reported eight were bilateral, one on right side and four on the left.

Of the thirteen cases reported there were eleven deaths and two recoveries. Of the eleven deaths, three occurred four days after the onset, one occurred eight days after onset and in three cases date of death is not given.

The author's case is interesting because of the wide variation of the symptoms in comparison to those related in the above cited thirteen cases.

Primarily there was no heart lesion or any other demonstrable focus of infection accountable for the onset. Besides the symptoms and signs which conform to those of renal infarction above present the author's case presented the following confusing symptoms:

1. A "septic type" of fever curve, temperature ranging as a rule between 102° and 105°.
2. Profuse perspiration.
3. Leucocytosis ranging from 23,000 to 37,000.
4. Repeated chills.
5. The outbreak of a rash resembling that of typhoid fever.

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ANOMALOUS RENAL VESSELS

SUPPLEMENTARY REPORT OF FOUR CASES

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At the last meeting of this Association the writer reported 4 cases[1] of anomalous renal vessels associated with ureteral obstruction and hydronephrosis. From these cases and from a further study of 50 autopsies in which 10 instances of anomalies of renal blood supply were found, we endeavored to draw some conclusions as to whether the anomalous vessels were the primary or secondary cause of the patient's symptoms.

The present 4 cases showed all the characteristic symptoms of the first group. The ages of these patients ranged from eighteen to thirty; 3 were women; 2 cases were on the right side and 2 on the left. They complained of sudden attacks of pain resembling renal colic, coming on out of a clear sky lasting from one to several hours, usually requiring morphine for relief. Attacks recurred in 2 cases every few days, in others at intervals of weeks or months. The urine in 2 cases was normal, in 1 there was a slight hematuria and in the other a frank pyuria. This group of symptoms in young adults always strongly suggests the possibility of the presence of an anomalous vessel, and the diagnosis was further supported by the pyelograms, all of which showed a constriction or kinking of the ureter at or near the uretero-pelvic junction with dilatation of the kidney pelvis and calices. In 2 of the cases a stricture of the ureter was present, a fact which has considerable significance in our conclusions concerning the method in which anomalous vessels produce their effect.

[1] Anomalous renal vessels associated with ureteral obstruction and hydronephrosis. Trans. American Association of Genito-Urinary Surgeons, xix, 1926, 105–121.

An abstract of the 4 cases follows:

Case 1. W. L., aged seventeen, student. Previous history negative, always strong and well. For the last two years this patient has been having sharp attacks of pain in the right kidney region, coming on sud-

FIG. 1

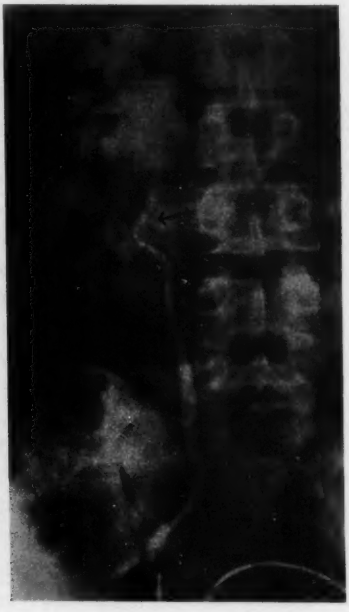

FIG. 2

FIG. 1. CASE 1. URETERAL KINK AT URETERO-PELVIC JUNCTION
Anomalous artery present but main obstruction due to a dense fibrous band above artery.

FIG. 2. CASE 1. PYELOGRAM FIVE WEEKS AFTER OPERATION SHOWS URETER HAS BEEN FREED BUT IS REDUNDANT

denly and lasting several hours, at times accompanied by nausea and vomiting, and often requiring morphine for relief. These attacks varied in severity and frequency. At first they occurred every few months, recently every two or three weeks. Between attacks the patient felt perfectly well. The pain was always in the kidney region, well around

in the back, never referred to the groin or testis. No blood or pus was ever found in the urine. During attacks there was definite tenderness in the right kidney region and a mass suggesting an enlarged kidney could be distinctly felt. From the age of the patient and the typical history of intermittent obstruction the presence of an anomalous vessel was suspected.

Ureteral catheterization showed normal function in the left kidney and considerably delayed appearance and diminished output of dye on the right side. The pyelogram (fig. 1) showed a marked kinking of the ureter at the uretero-pelvic junction with a hydronephrosis as yet uninfected.

At operation a definitely pulsating vessel of moderate size was found extending from the aorta to the lower pole of the kidney. After this was ligated and cut, it was seen that the ureter was still bound down and the obstruction had not been relieved. It was only after a dense fibrous band above the position of the anomalous vessel had been cut that the ureter was freed up to its entrance to the diated pelvis. The pelvis could be seen to empty when this band was removed.

This seems to bring out the important fact that in some cases the ligation of the anomalous vessel is not enough to relieve the obstruction, and may explain the failure to obtain results reported by other surgeons. The kidney was fixed in as high a position as possible to take up the slack of the redundant freed ureter.

The patient made an uneventful recovery, and five weeks after operation a second pyelogram was made to determine the course of the ureter (fig. 2.) In the nine months since operation no attacks of pain have occurred and the patient has gained 15 pounds in weight.

Case 2. R. D., female, aged twenty, nurse. Sharp attacks of pain in the region of the left kidney during the last year, coming on at irregular intervals of from a few days to several weeks. These attacks incapacitated the patient so that she lost considerable time from her training period as a nurse. The pain lasted several hours, often required morphine and at times caused vomiting. Definite tenderness over the left kidney, but no mass palpable. Urine uniformly negative. By ureteral catheterization, normal function was established in the right side, diminished function on the left.

Pyelogram (fig. 3) showed a constriction at the uretero-pelvic junction with a moderate uninfected hydronephrosis. At operation a moderate sized anomalous vessel was found extending across the ureter to

the lower pole of the kidney. The real obstruction, however, was caused by a fibrous band accompanying the vessel which could well be interpreted as another atrophied anomalous vessel. The division of this band freed the ureter.

FIG. 3

FIG. 4

FIG. 3. CASE 2. DISTORTION OF URETER DUE TO ANOMALOUS ARTERY AND FIBROUS BAND

FIG. 4. CASE 3. URETERAL OBSTRUCTION DUE TO PRESENCE OF ANOMALOUS VEIN AND ARTERY

The patient made a rapid recovery and during the six months since operation has had no further attacks of pain, and has lost no time from her work.

Case 3. G. B., aged twenty-seven, female. For last two years has had attacks of pain and burning on urination, accompanied by colic-like pain in the left kidney region. The kidney was distinctly palpable during attacks and tender to percussion. The urine contained colon bacilli and considerable pus. The pyelogram (fig. 4) showed a beginning hydronephrosis and a distinct constriction in the ureter at the ureteropelvic junction suggesting the presence of an anomalous vessel.

At operation, which was done by an associate, a large pulsating vessel was found, extending from the aorta to the lower pole of the kidney constricting the ureter. This was ligated and cut with some misgivings on account of its size. There was a sharp temperature reaction for two or three days, after which the patient went on to a good recovery. On account of the infection in the kidney, pelvic lavage was done during the convalescence with apparently beneficial results. During the eight months snce the operation the patient's condition has greatly improved. Pathological examination of the block of tissue removed showed the presence of both an artery and a vein.

Case 4. M. D., aged thirty, male. During the last ten years this patient has had at varying intervals, attacks of colic-like pain in the region of the right kidney. These attacks have been more severe since an accident he had three years ago when he received a severe blow in the right flank. Recently he has not been able to work and has lost 15 pounds. Examination is negative, except that the right kidney is tender to deep percussion. The urine at times contains a few red blood cells, otherwise negative.

The pyelogram (fig. 5) shows a peculiar constriction in the ureter some distance below the pelvis, which suggested a post-traumatic stricture of the ureter. At operation, however, a distinct fibrous band was found which extended from the aorta to the lower pole of the kidney. From its course it was considered much more likely to be an atrophied anomalous vessel than the result of trauma, especially as the symptoms had existed for years before the accident. The ureter presented a real stricture which it was necessary to dilate after opening the ureter above it. The patient in the few months since operation has been completely relieved.

There are several points in the treatment of these cases which deserve discussion. One must first decide whether it is wiser to sacrifice or to attempt to save the affected kidney. Certain

authors have expressed the opinion that in the majority of these cases any form of plastic treatment is not followed by good results, and that it is better to do a nephrectomy if there is normal function in the other kidney; we believe that is far too radical a position to take. We feel that a kidney with a greatly dilated pelvis, with practically no function and especially with marked infection should be removed. In these young patients, however,

FIG. 5. CASE 4. OBSTRUCTION CAUSED BY FIBROUS BAND INTERPRETED AS AN ATROPHIED ANOMALOUS VESSEL

in the absence of infection, even with a considerable degree of hydronephrosis and diminished function, we think it wise to save the kidney on account of the recuperative power the organ is known to possess if the obstructing factor is removed, and proper drainage re-established. In our series of eight cases it was found necessary to remove but one kidney. Case 1 of the present

series illustrates an attempt to save a kidney with a marked degree of hydronephrosis and a moderate diminution of renal function, but without infection. We have not been able to persuade the patient to have another pyelogram made ten months after operation to see if the hydronephrosis has receded, he is

FIG. 6

FIG. 7

FIG. 6. AUTOPSY SPECIMEN. KIDNEY WITH ANOMALOUS LOWER POLAR VESSEL
Injection of normal circulation showing uninjected portion in lower pole supplied by the accessory artery. (Preparation by Dr. H. R. Trattner.)

FIG. 7. SAME SPECIMEN AS FIGURE 6
Injection through the anomalous vessel indicating the amount of kidney tissue which will be deprived of its blood supply in the average case. (Preparation by Dr. H. R. Trattner.)

too well satisfied with his present condition and his scientific curiosity does not equal ours.

If the operator attempts to save the kidney the next point for him to decide is whether he will tie off the anomalous vessel and deliberately sacrifice the circulation of the portion of the kidney

it supplies, or whether he will reimplant the ureter into the kidney pelvis in a position where the anomalous vessel cannot obstruct it. Unless the vessel is of unusual size, its ligation need cause the operator no concern. In 2 of our cases the vessel was as large as an average size goose-quill, and after its ligation no reaction developed in 1 case; in the other there was a sharp rise in temperature for three days. Quinby has reimplanted the ureter successfully in a number of cases; we have not found it necessary thus far. Figures 6 and 7 show the amount of renal tissue that will be deprived of its blood supply by the ligation of an average size anomalous lower polar vessel.

The third point which seems important to us is the recognition of the fact that the ligation of the anomalous vessel does not always remove the obstruction. It is necessary to follow the ureter up to its insertion into the renal pelvis and in doing so one often finds firm fibrous bands which seem to be producing even more obstruction than the vessel itself. After the ureter is thoroughly freed, it should be carefully palpated for evidence of stricture. If any narrowing seems evident it is easy through a nick in the pelvis, to pass a ureteral bougie down through the strictured area. Thus far all of these patients have been relieved of their attacks of pain, although sufficient time has not yet elapsed to tell whether a permanent cure has been secured.

We have been studying a further series of autopsy cases to get statistics on the frequency and type of anomalies of renal blood supply, on which we are not yet ready to report.

The second group of cases which we have met with in the last year has convinced us that anomalies of renal blood supply, associated with urinary obstruction, are not uncommon. We have no reason to modify the conclusions we reached last year—that the mere presence of an anomalous vessel to the lower pole of the kidney is not enough in itself to produce symptoms, as is proved by autopsy specimens in individuals beyond middle life, anomalous vessels to the lower pole were present with no evidence of urinary obstruction. On the other hand, the anomalous lower polar vessel may act as the primary or secondary cause in producing symptoms. It can be the primary cause in cases where the

size and course of the vessel in itself produces pressure on the ureter and intermittent urinary obstruction. These are the cases which are found in very young patients from the ages of eight to fifteen years. It can be the secondary cause of symptoms in patients in which various types of obstruction of the lower ureter cause the formation of a hydronephrosis and the anomalous vessel only begins to act when the congested kidney begins to sag and drag the ureter over it.

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JAUNDICE DUE TO MOVABLE KIDNEY

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A movable kidney is occasionally responsible for gastric and gall bladder complaints due to tension and displacement of its attachments and peritoneal coverings. The literature on the subject is very scant. Bramwell (1) cites a case of death from gastric distension in which autopsy revealed a constriction of the duodenum by three distinct bands of thickened peritoneal tissue which gradually spread out over a freely movable right kidney, traction on the bands dragged on the pylorus and produced the distension. Peritoneal tension, due to a kidney displaced traumatically or otherwisc, may at times obstruct the bile ducts and initiate a chain of symptoms such as pain, nausea, and jaundice, indistinguishable clinically from true gall bladder disease. I have recently observed a case of this kind; but before giving its detailed clinical history I will shortly refer to what I could find in the literature bearing on the subject.

Maclagan and Treves (2) report three cases in which a movable kidney produced symptoms of gall stones; on abdominal exploration all cases were found to have negative gall bladders and bile ducts and complete cures were obtained by fixation of the kidney. Hutchinson (13) reports two similar cases in which abdominal explorations and later kidney fixations were performed. In one case, the patient, a woman of twenty-eight, came for relief of jaundice and vomiting; she had clay colored stools and bile in her urine; her weight had dropped from 168 to 98 pounds. The gall bladder and bile ducts were explored through an abdominal incision and found normal, but a floating kidney was discovered which was suspended through an extraperitoneal incision. The stools immediately became normal in color and the patient recovered.

Just as gall bladder disease occurs more frequently in women than in men, movable kidneys are also more common in females; Kelly (3) found that one in every five women had a movable kidney as compared with one in every fifty men. Not infrequently in men, as in my own case, there is a history of trauma that may possibly be related to the displacement of the kidney. White (4) reported a case of a man who was knocked down from a blow in the back; seventeen months later he was jaundiced and had bile in his urine. On examination a movable kidney was found for which a nephropexy gave permanent relief.

Movable kidney and cholecystitis are not infrequently found associated in the same individual. If a displacement of the kidney and its attachments retards or obstructs the flow of bile it may possibly in some cases be an indirect cause of gall stones and at times it is extremely difficult to definitely determine the primary cause of the symptoms present. In one case in which gall stones were found, the right abdominal pain and discomfort remained unchanged after cholecystectomy; on cystoscopic examination a right movable kidney with considerable torsion was found. This association of movable kidney and gall stones is quite a common one but it is difficult to prove any direct relationship between the two.

PRODUCTION OF JAUNDICE BY MOVABLE KIDNEY

Movable kidneys do not move freely up and down under the peritoneum. The peritoneal folds are usually quite adherent to the kidney surface; and, in cases of long standing displacement, the peritoneal folds are at times markedly thickened. Bramwell (1) states that when the kidney moves downward it carries its peritoneal covering with it and thus stretches the superior and internal reflections of the peritoneum which pass upward and over the pylorus and neighboring structures until in aggravated cases distinct bands are formed. Gallant (5) attributes the jaundice in cases of movable kidney to traction of the kidney on the cystic or common duct. Horizontal posture allows the kidney to recede enough to relieve the tension on the ducts and puts an end to biliary obstruction. Deaver (6) believes that the condition is due

indirectly to a kinking of the common duct by traction. Byron Robinson (7) states that the perirenal areolar tissue binds the kidney to the diaphragm and that at the upper renal pole it fuses with the suspensory ligament of the liver on the right side. If the kidney drops down, its peritoneal and subperitoneal tissue connections may produce traction on the biliary passages, flexing and obstructing them. In one subject Robinson found a peritoneal band extending from the kidney to the common duct.

The normal right kidney is closely associated with the second part of the duodenum which rests on it; the pelvis of the kidney is on the same level and a little to the outer side of the orifice of the common bile duct; and the lower end of the kidney is about level with that of the duodenum. Lindner (8) has shown that a right movable kidney drawn forwards and downwards causes traction on the duodenum at a point two or three cm. below the entrance of the biliary duct; and, though it does not occlude the lumen, it may interfere with the contents of the bowel sufficiently to impair digestion and to cause biliary obstruction. Stiller (9) and Kuster (10) both believe that the upper abdominal pain and jaundice associated with movable kidney come from a pull on the fixed, descending part of the duodenum and obstruction of the papilla of Vater. Weisker (11) states that a hepato-renal band exists, such accounting for the dragging on the neck of the gall bladder by the movable kidney.

Keith (12) in dissecting a cadaver with a movable kidney, in the London Hospital College, found that the axis of the gall bladder had become almost vertical and formed an angle of twenty degrees with the common bile duct. The third part of the duodenum had been so displaced that it rested on the common iliac artery and the orifice of the bile duct was at least one vertebra lower than normal. Hutchinson (13) states that such kinking of the cystic duct as was seen in this specimen must impede the escape of bile from the gall bladder; he considered that the occurrence of obstructive jaundice with movable kidney may result from any of the following three conditions: (*a*) a downward displacement of the third portion of the duodenum with a stretching of the common bile duct; (*b*) a displacement of the gall bladder

and sharp kinking of the cystic duct; (c) torsion of the vertical part of the duodenum and perhaps even of the bile duct.

The following personal case is one in which a kidney was torn from its fossa by trauma; it was replaced in the fossa by surgical operation and sutured to the neighboring structures. Later on a further trauma again caused the kidney to leave its normal location resulting in a strain not only on the usual attachments but also on those formed by the suspension procedures.

CASE REPORT

A. G. B., a male, aged fifty-five, complained of jaundice with pain in the upper right quadrant of the abdomen.

Past history. Twenty-three years ago he was struck in the right lumbar region by a falling rock. On examination it was found that his right kidney had apparently been bruised and was abnormally movable. The kidney was explored through a right postero-lateral incision; it had been torn from its usual location and partly lacerated. The lacerations were repaired and the kidney sutured back in place. The patient had no further trouble until the present illness.

Present illness. Eighteen months ago he fell thirty feet and stopped himself with a sudden jerk by catching a beam with his hands and arms. Several weeks after this he had an acute attack of pain in the region of the gall bladder; the pain lasted several days and was associated with gastric distress, nausea, and definite jaundice. Several times during the last eighteen months he has had similiar but milder attacks consisting mostly of epigastric distress and nausea during which time cold sweats broke out. The patient stated that he had been quite well the three months previous to his present attack.

One week before entering the hospital patient had a sudden onset of pain in the epigastrium, associated with abdominal distension. The pain, which was severe and colicky, radiated to his right shoulder and has persisted up to the present time. Several days ago he noticed that his skin and eyes were becoming increasingly more yellow, that his urine was highly colored and the stools pasty and white.

Physical examination. Skin, sclerae and mucous membranes colored a deep yellow. There was moderate abdominal distension and tenderness in the gall bladder region; no abdominal masses or organs were felt. There was a straight scar 7 cm. long in the right posterior renal

area. The lungs were clear and the heart sounds normal and regular. Temperature normal.

Laboratory data. The urine contained bile with an occasional pus cell, but was otherwise normal on several examinations during the first week of his stay in the hospital. The specific gravity varied from 1010 to 1104.

Blood examination revealed a moderate leucopenia, 6000 and 8000 leucocytes being found in two examinations. The hemoglobin, red blood cell count and differential white cell count were not abnormal. The Wassermann test was negative. The icteric index of the blood varied from five to nine times the normal amount. The Vanderberg test on one occasion indicated a hemolytic type of icterus and on another occasion, when the jaundice was most intense, it gave an immediate, direct reaction indicative of a complete obstructive type of jaundice. The bleeding time was five minutes, and the clotting time three minutes. The non-protein nitrogen was 37 mgm. per 100 cc. of blood. The salivary urea several days later was 56, indicative of a non-protein nitrogen of 47.

The stool at the height of the jaundice was negative for bile. Several days later urobilin was present.

X-ray examination. Fluoroscopically the stomach and duodenal cap were negative for demonstrable involvement, though there was a slight gastric residue after six hours. A radiogram of the gall bladder, kidney and urinary bladder revealed a collection of shadows, apparently renal stones, 0.5 to 2 cm. in diameter in the right lumbar area; this area was limited above by the twelfth rib and below by the iliac crest; neither kidney could be outlined.

Marked jaundice was present and all symptoms indicated gall bladder trouble. On the eighth day of his stay in the hospital the patient complained of moderate frequency of urination and discharge from the urethra. The discharge was of small amount, mucoid, and only of some hours duration. An examination of the urine at this time revealed numerous pus cells and many colon-like bacilli. The appearance of a pyuria coupled with the history of a previous operation on the right kidney necessitated a cystoscopic examination before surgical intervention in the right upper abdominal area could be considered.

Cystoscopy showed moderate, bilateral, intraurethral enlargement of the prostate. The bladder contained two ounces of residual urine and the bladder wall was trabeculated. Both ureteral orifices were normal in appearance. Regular spurts of clear urine came more frequently

than normally from the left orifice. Intravenous indigo-carmine returned a deep blue in four minutes from the left kidney; no blue was seen coming from the right side in twenty minutes. The right ureter was catheterized and 150 cc. of thick, cloudy fluid withdrawn with a syringe. A right pyelogram revealed an extensive dilation, obliteration of all the calices, and an almost complete destruction of the renal parenchyma; the irregular shadows seen in the original x-ray were obscured in the pyelogram. A catheter was left in the ureter for drainage. Six hours after cystoscopy the patient was free from all pain in the gall-bladder region, the jaundice decreased in amount, and the stools were darker. Forty-eight hours later the catheter was removed following which the patient had a severe chill, the jaundice became more intense, there was an immediate, direct positive Vanderberg test, the icteric index went up to 65 (13 times the normal), with severe pain and tenderness over the gall-bladder region. A ureteral catheter was again inserted in the right ureter for semi-permanent drainage, and the kidney pelvis washed out with a 1 per cent solution of mercurochrome every four hours. The following day the jaundice began to clear very rapidly, pain ceased and the stools were brown. Two days later the jaundice had practically disappeared.

The catheter was left in place for six days following which the patient was in good condition, with practically no pain and the urine from the right kidney contained only a small amount of pus.

Operation. (Dr. H. E. Schiffbauer.) The kidney was exposed through a right lateral incision; the old scar was excised. The kidney was found distorted with extensive peri-renal adhesions which were separated by sharp dissection. The renal pedicle was dissected out, clamped and ligated in two places and the kidney removed. The kidney was almost completely destroyed; it was hydronephrotic, dilated and composed of only a shell of parenchyma containing a number of stones varying in size from 5 mm. to 2 cm. in size.

There was no further jaundice following operation, no abdominal pain or gastric discomfort, and eight months later the patient felt quite well.

COMMENT

In this case the clinical findings, symptoms, and laboratory data all suggested a lesion of the bile passages. As in cases of true gall bladder and bile duct disease the evidence on which a

diagnosis was based was mainly presumptive. It was impossible to absolutely exclude a coincidental lesion of the gall bladder as the cause of the symptoms. On the other hand after complete relief of all symptoms from permanent ureteral drainage, the catheter was deliberately removed to see if this would cause a return of symptoms; the prompt return of pain and jaundice suggested a close causal relationship. A second ureteral catheterization again gave him relief and was continued until the time of his operation.

Ureteral drainage in this case not only gave the patient relief from symptoms but by decreasing the size of the kidney and draining out most of its infected contents it facilitated the operative removal and reduced the possibility of contamination of the surgical field.

The jerk caused by the sudden stop in the patient's fall, which occurred two years ago shortly before the appearance of his abdominal symptoms, must have exerted a terrific pull on his body and the suspended right kidney. This very probably was sufficient to cause the kidney to shift position, carrying its peritoneal coverings, fascial attachments and perirenal tissue, en masse, downward. The adhesions resulting from his previous operation were very dense and the extreme difficulty which occurred in freeing the kidney during the nephrectomy indicated that the kidney had not only slipped out of place by itself but that it had carried down all the perirenal and overlying tissues with it.

It is difficult to understand how the catheter drainage of a small infected hydronephrosis would relieve such intense jaundice. There was a marked perinephritis present which might readily have extended to the bile passages. Drainage of the kidney would permit this extrarenal infection to subside, thus clearing up the pain and jaundice.

The upper abdominal pain associated with movable kidney and secondary biliary disease is rarely as severe as occurs in acute gall stone colic and it is usually relieved by the prone position; lying down relaxes the pull on the bile ducts and relieves obstruction. In the early stages there may be only slight traction on the ducts

causing mild attacks of a bilious nature, a sense of gastric discomfort and nausea. In one case reported the patient, described his attacks as "weakness and sweating." The pain usually does not have the sudden onset or cessation such as occurs in calculus obstruction. Gastric disturbances, nausea, vomiting, and a general sense of epigastric discomfort are usually present.

Gall bladder symptoms resulting from movable kidneys most frequently occur in thin, young, adult women differing from the common fleshy type of women usually suffering from gall bladder disease. The jaundice is generally mild, intermittent, and of short duration, lasting from one to several days. In an occasional case there may be almost complete obstruction together with an associated, secondary inflammation of the bile ducts. In the acute type of obstruction, similar to that occurring with common duct stone, the urine contains bile and the stools are clay colored.

During the onset of symptoms in the above case the Vanderberg test did not show a completely obstructive type of jaundice. Later, an immediate, direct reaction was obtained indicating that the obstruction had become complete. This condition persisted until the kidney was drained through the ureteral catheter which permitted the remaining shell of renal tissue to collapse and either to shift back into a more normal position or to release the pressure on neighboring structures.

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PUNCTURED WOUND OF THE KIDNEY

H. G. HAMER

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Incised and punctured wounds of the kidney are sufficiently rare in civil practice that the following case is deemed worthy of reporting:

On March 13, 1927, Mr. W. S., a farmer, twenty-four years old, was seen in consultation with his family doctor. He had been admitted to the Methodist Hospital eight hours previously, complaining of a punctured wound in his right loin and an accompanying hematuria.

His story was essentially the following: He was returning to his home at about 11:00 p.m. March 12, 1927, driving a small coupe. It was raining and when he attempted to pass an approaching automobile the lights blinded him for an instant and he ran off the road. His car upset shattering the glass windows. He was conscious of a sharp, stinging pain in his right side. He crawled out of the overturned car and walked to a farmhouse some little distance away. A wound in his back was bleeding quite freely and in about fifteen minutes after the accident he had a desire to urinate. His urine had the appearance of almost pure blood. He walked to his car, which had been righted by passing motorists, and drove 9 miles to his family doctor who packed his wound with gauze and took him to the Methodist Hospital 20 miles distant.

He was radiographed in both the antero-posterior and lateral positions and a definite wedge-shaped shadow 3 inches long and ½ inch wide at the base was apparent at the level of the upper border of the second lumbar vertebrae with its apex pointing inward, downward and anteriorly. A bulb-like configuration was made out near its sharp-pointed apex.

On physical examination the patient was a well nourished white male with a small incised and swollen wound in his left loin below the last rib and about 4 inches from the center of the spine. Save for some slight dullness and rhonchi in his left chest in front, his physical examination was negative. His temperature was 99.4°, pulse 80, and respiration

22. Blood count: Red blood cells, 4,500,000; white cells, 8500; hemoglobin, 85 per cent.

Because of the fact that the glass sliver had penetrated his top coat, coat, vest, shirt and underwear, and that there was apparent damage to his kidney substance, it was decided to expose the kidney to ascertain the extent of injury.

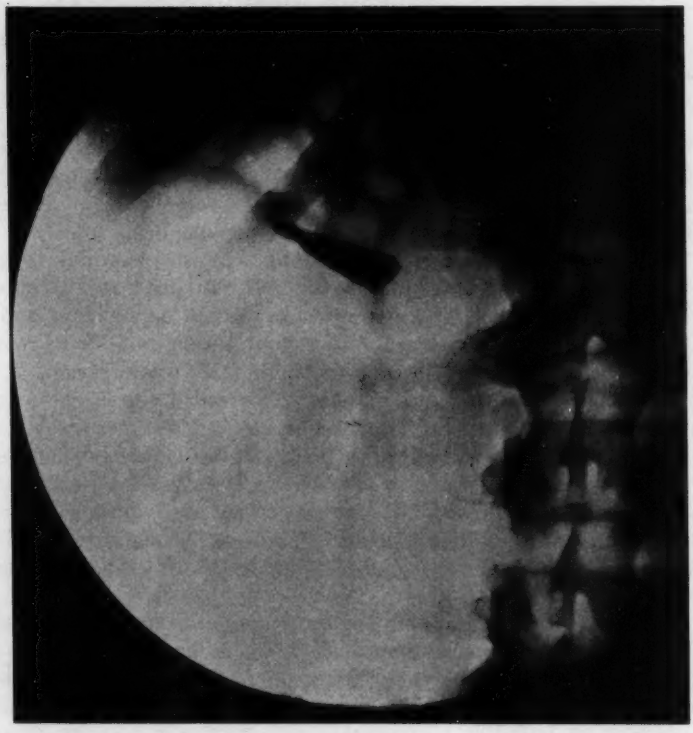

FIG. 1

At 2:40 p.m. the patient was operated upon under gas anesthesia. Through the usual oblique loin incision, the upper angle of which included the puncture wound a sharp-pointed, wedge-shaped piece of glass $2\frac{3}{4}$ inches long by $\frac{1}{2}$ inch wide at the base and $\frac{1}{4}$ inch thick was

removed. The glass had punctured the erector spinae muscles at the costo-vertebral angle and had penetrated the cortex of the kidney to a depth of ¾ inch. The kidney was surrounded by a large mass of blood clot. The hematoma surrounding the kidney was cleared away and the punctured wound of the kidney which was large enough to admit the tip of a finger packed with iodoform gauze. The wound was drained with a gauze strip and was closed in layers in the usual fashion. No evidence of injury to surrounding viscera was found.

On March 14, 1927, the temperature was 101°, pulse 96, respiration 36, urine red but transparent. There was some increased dullness in the left chest and cough was pronounced. The abdomen was tympanitic.

On March 15, 1927, the temperature was 101°, pulse 104, and respiration 32. The urine was almost clear. The chest was not so dull and rhonchi less pronounced. The cough was better.

On March 16, 1927, the temperature was 100°, pulse 80, respiration 24, urine macroscopically clear and cough much better.

Urine drained through the wound for six days following the injury, then ceased and the wound healed firmly. The voided urine soon became clear macroscopically, and microscopically showed only a few blood cells.

The patient left the hospital on the twenty-fifth day.

The uneventful progress to recovery undoubtedly was due to the fact that the wound did not involve the vascular pedicle of the kidney or its pelvis to any considerable degree nor any of the surrounding viscera and that no foreign body remained in the wound.

THIRD DAY, MAY 11, 1927

GENESIS, MORPHOLOGY, AND SURGERY OF PROSTATIC MIDDLE LOBE HYPERTROPHY

ALEXANDER RANDALL

The unique and uniformly successful development of the clinical surgery of prostatic hypertrophy during the past quarter of a century has now come to a stationary point. The lethal quotient has been brought almost to an irreducible minimum and at the same time a brilliant epoch of clinical advancement and clinical achievement has been recorded. It is another example, among many, where under the urge of necessity, by bold and intensive studies, clinical surgery has rapidly outdistanced the fundamental sciences in our knowledge of an organ, but it leaves a tremendous void which must be filled before further advance can be expected.

Taking stock today finds us without accurate knowledge on many fundamental facts. For instance, what is the normal physiological function of the prostate? Has it an internal secretion? What part does it play in micturition? What part does it play in our sexual life, etc.? An equal lapse in our knowledge exists when one tries to correlate the various studies on the pathology of benign prostatic hypertrophy. We have not yet decided whether it be an hypertrophy or an hyperplasia. We do not know its etiology, are not in agreement as to where it starts, nor as to how growth proceeds. Residual urine accumulation is no more the simple problem of a dam in the stream, with its pool behind it, than is the wonderful rejuvenation following prostatectomy due alone to better sleep, kidney function, and normal micturition. There are deeper physiological and pathological problems here awaiting investigation. Hence it is that I wish to present to you today some studies on the genesis, morphology and surgery of the middle lobe of the prostate, a portion of the gland whose terminology is vague, whose growth is probably the most obstructive, whose diagnosis is difficult and whose sur-

gery is most important, taking for granted that we all recognize today that in hypertrophy the prostate does, at times, form a midline lobular mass which we term clinically a middle lobe.

The point of origin of all prostatic hypertrophies has interested numerous investigators. I do not wish to trouble you with a citation of the conflicting theories. They are familiar to you all. It is a fact, however, that throughout the literature there seems to run a constant tendency to attempt to make one theory of *origin* or of *location* to fit all cases of hypertrophy, rarely allowing for variation from one supposedly fixed standard location, or origin, of growth. For instance, Tandler and Zuckerkandl advanced the theory fifteen years ago that the first changes always occur in the tissue lying in the midline, otherwise called the posterior commissure and that hypertrophy is never absent at this point. Tandler, in the 1922 edition of his work with Zuckerkandl, spends the greater part of the text in correcting this previous statement and now attempts to prove that the hypertrophy arises superficial to this glandular tissue and presses this posterior commissural tissue backward. This is adopting the work of Motz and Perearneau that hypertrophy always originates in the superficial "mucosal glands" closely surrounding the urethral lumen, a point of view that seems to have received rather general acceptance, except in occasional instances. These are but two examples among many of the tendency of investigators to ascribe the origin of hypertrophy to one fixed group of gland acini, a tendency to dogmatize that I cannot but feel is the resultant offspring of studying too small a series of specimens. It has been my experience to find such a variety of types of hypertrophic growth that it has been hard to classify them into groups, and absolutely impossible to bring oneself to feel that the origin and location has been uniformly the same in all cases. In other words, it has been impossible to correlate my findings with the idea that hypertrophy invariably originates in or at any one fixed area, or in any one set group or prostatic gland acini. But on the contrary, I believe that hypertrophy may originate in any one lobe of the prostate, with the possible exception of the true posterior lobe. This means that the glandular tissue of the right and the left lateral lobes,

the glands of the anatomical middle lobe or posterior commissure, and the subcervical gland of Albarran, are the tissues sharing in hypertrophic proliferation, and that any one, or any combination of these may be the seat of the origin of the growth.

If you will accept these statements that hypertrophy may originate in any of these locations, you will immediately appreciate that we should find a marked variety of contours or shapes in different specimens. We should find solitary lateral lobe hypertrophies, solitary commissural hypertrophies, solitary Albarran's subcervical gland hypertrophies, also we should find combinations of any two of these, or all of them together. It has been possible in studying my material to prove these statements, but today I wish to confine my remarks to the hypertrophies occurring in the midline and obstructing the posterior vesical lip, either as solitary growths or in conjunction with lateral lobe enlargement.

I believe there are two absolutely different enlargements called by the same name of "middle lobe." Anatomically, there are two different glandular elements situated in the midline posteriorly: first, the posterior commissural glandular tissue, and secondly, the subcervical glandular tissue of Albarran. Either may undergo hypertrophy independently of the other, or independently of lateral lobe growth. Likewise, either may grow in conjunction with lateral lobe enlargement. As they have essential anatomical differences in their attachments, and encapsulations, they present a different gross pathological picture and differing surgical problems for their approach and successful removal.

The posterior commissural tissue is the anatomical middle lobe, a definite mass of glandular tissue, macroscopically visible, contiguous with the lateral lobe glandular tissue, sharing with them the true prostatic capsule and not showing any separating capsule or fibres. This glandular commissural tissue is apparently almost always present, though there appear to be exceptions to the rule, and Lowsley reports such a case in his series of microscopic studies, and Albarran reports four specimens where it was absent in his series of 111 specimens studied, and I feel it may be more frequently absent. Possibly in some cases it may

be destroyed by inflammation or in others pushed back and compressed, as Tandler would explain it, by lateral lobe growth.

On the other hand, when the posterior commissural glandular tissue does hypertrophy, it first causes a thickening and elevation of the posterior vesical lip, and at this stage I have been prone to speak of such as glandular median bars. Macroscopically, at this stage, there may be no evidence of lateral lobe hypertrophy. On further hypertrophy, the commissural tissue raises upward the apex of the trigone, the vesical lip and the first portion of the floor of the urethra. The sphincter gradually drifts backwards and behind the hypertrophying mass, and the hypertrophy is constantly confined by the prostatic capsule and always under the trigonal muscle. It ultimately grows to form a thumb-like projection into the bladder cavity, broad, flat, sessile, with widely separated clefts in the posterior-lateral angles. In long standing cases, and those showing massive enlargement, some hypertrophy of the lateral lobes becomes evident, or in my most marked cases, it shares an equal part with lateral lobe growth. It is a stoggy, dullard of a country bumpkin variety as compared to its companion growth, the dainty, artistic, symmetrical, poised and graceful subcervical gland hypertrophy of Albarran (French to the last degree).

These latter (subcervical hypertrophies) start as a small rounded nodule just infra-sphincteric and quickly become spheroidal in shape; by the time they are large enough to push up through the sphincter, pedunculation has started and from then on this characteristic is never lost and never absent. Its only covering is the mucous membrane and its only attachment its own ducts forming a definite pedicle. There need be no lateral lobe enlargement, and even if present, there being no common capsule, there is no tissue attachment to the same or glandular continuity. It stands along as a spheroidal, pedunculated lobular mass, and may grow to an equal size of any prostatic lobe.

The query may be put as to which of these do we mean when the term "middle lobe" is used.

The differentiation between these two entities, posterior commissural hypertrophy and subcervical hypertrophy, is not an

academic question only, for it is an important matter when it comes to the proper and complete removal at operation and the recognition of the type present preoperatively should change the technique of enucleation which, if made to suit the case at hand, insures radical and clean removal, minimizes damage to contiguous structures, and lessens the danger of post-operative bleeding.

The differential diagnosis can be made by combined rectal and cystoscopic study.

The posterior commissural hypertrophy, on rectal examination, presents a flattening out of the mid-prostatic groove with a broad flaring out of the upper lateral lobe limits, and a greater tissue mass in the inter-vesicular, sub-trigonal region. Cystoscopically, one appreciates a generalized thickening of the posterior vesical lip, a partial, or complete, obscuring of the trigone, and on retracting the instrument one seems to travel a long distance before actually entering the posterior urethra. Clefting, if present, is found far out in the lateral sulci, and if one but follows it, it leads into the posterior urethra, without meeting the one from the opposite side, while with an instrument in the urethra and a finger in the rectum, the thickened mass is readily appreciated as the instrument easily stays in the midline and rides over the hypertrophic lobe.

Subcervical hypertrophy, on the other hand, because of its one outspoken characteristic, that of pedunculation, presents easily recognized variations from this picture. It is an intravesical growth and cannot be felt by rectum under any circumstances, and when it alone is enlarged the rectal examination may be most unsatisfactory and even misleading. On passing the cystoscope, the instrument invariably enters to one side or the other of the lobe which on observation may be mistaken for the rotundity of a lateral lobe enlargement, and sometimes not until one looks directly upward do you catch the change of contour which if followed leads you (and the cystoscope) into the opposite cleft with a complete reversal of the picture. In even moderate size hypertrophies of this variety it is almost impossible to keep the instrument on the summit of the lobe and follow it into the urethra by drawing the cystoscope outward. But if you follow either

lateral cleft into the urethra it will be found to practically meet the one from the opposite side because of the narrow pedunculation. Rectal examination, while the instrument is in place, gives no increased thickening, as the instrument regularly lies lateral to the lobe. So one may say that the diagnosis of subcervical hypertrophy is made by cystoscopic examination alone.

Prostatic surgery of today has reached the state where instead of analyzing the mortality we study the post-operative morbidity of our patients. An ideal prostatectomy, whether done suprapubically, or perineally, should remove all hypertrophic tissue, restore normal function and last permanently. In order that this may be true, the actual enucleation should be performed by passing through the characteristic line of cleavage and never, if possible to remove a lobe except in toto, and where hypertrophy in one lobe is continuous with other adenomatous proliferation, the enucleation should continue until easy separation of the entire mass occurs.

The surgical deductions to be arrived at from the differentiation between posterior commissural hypertrophy and subcervical hypertrophy are very valuable for the clean, easy and truly surgical removal in each individual case, and a pre-operative appreciation of the work ahead expedites the procedure, facilitates a clean enucleation, minimizes hemorrhage and insures permanency of cure.

In *posterior commissural hypertrophy*, when also associated with lateral lobe enlargement, is approached suprapubically, the enucleation, starting intra-urethrally, sweeps about one lateral lobe and should pass across the urethra and the apex of the trigone and the finger goes, without difficulty of any degree, directly around the opposite lateral lobe and the prostatic mass is removed in one piece. If the commissural hypertrophy is present without lateral lobe enlargement, the break through the mucous membrane must be made in a cleft at either of the lower lateral angles of the internal vesical orifice and commissural tissue alone enucleated.

If the approach be from the perineal side, the greatest care must be exercised that a lateral lobe be not removed from either

capsule and the commissural tissue, (undoubtedly the most obstructive portion), missed entirely. In such a case the Hinman modification of Young's prostatic incision is ideal, and one should again endeavor to keep the adenoma intact and hugging the capsule obtain a single mass enucleation.

In *subcervical lobe hypertrophy*, on the other hand, when approached suprapubically, the characteristic pedunculation and the knowledge that its capsule consists only of mucous membrane, permits the surgeon to pinch it off the first thing. You cannot, nor should not, save its mucous membrane, all of which is redundant and I am in the habit of placing a clamp on the lobe and simply twisting its pedicle to the point of rupture. Occasionally I have ligated the pedicle first but doubt the utility.

In perineal prostatectomy a subcervical hypertrophy presents a peculiar complication all its own. As it does not lie within the prostatic capsule and as that structure is entered on its posterior surface, a complete lateral lobe and commissural growth may be removed and a subcervical lobe hypertrophy missed entirely. Neither can such a lobe be made to present itself into a lateral lobe cavity unless the urethral lumen has been entered and then only the lobe may be dislocated so as to enter first the posterior urethra, then a lateral lobe cavity, and from thence to the perineal exposure. If clean enucleation has been performed on the lateral lobes, the preferable and only way to remove such a subcervical lobe in perineal prostatectomy is to withdraw the prostatic tractor entirely and with a spoon retractor, or lobe forceps, entered through the urethrotomy incision, grasp the lobe and attempt to draw it down through the posterior urethra to a point where its attachment can be ruptured and the mass removed. This complication is the most serious objection to a perineal prostatectomy in such cases, for though its removal can be usually accomplished, the possibility of complete oversight, the occasional difficulty of removal, the uncertainty of enucleating such a lobe without leaving behind redundant tags of mucous membrane, and when unusually large, the complete inability to reduce such a lobe to the perineal field—it being an intravesical tumor—all make me feel that such enlargements belong essentially to the suprapubic operation.

Such is the gross pathology of so-called "middle lobes" and their surgical bearing. Factors are present that I feel sure play important rôles in prompt convalescence and complete cures. The terminology has allowed of misunderstandings both in the literature, and in clinical teaching, and in society discussion, and I speak for your approval, that in the future, we eschew the use of the term "middle lobe" and purify our terminology on such occasions, by speaking of them as a lobe from either commissural hypertrophy, or from subcervical hypertrophy.

STUDIES IN CENTRIFUGALIZATION AS A MEANS OF IDENTIFYING TUBERCLE BACILLI IN THE URINE

A COMPARISON OF SIMPLE CENTRIFUGALIZATION WITH CRABTREE'S, JONES', PETROFF'S AND OTHER METHODS

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In looking over the literature relative to the detection of tubercle bacilli in the urine, one is impressed by the fact that the methods which have been devised and recommended during the past ten or twelve years are both complicated and time-consuming.

Simple centrifugalization, always a fairly reliable method, has been largely replaced by centrifugal methods so modified that, in their employment, only the most expert technician can hope to achieve success. Anyone who has supervised the laboratory work of the average hospital interne for a number of years (as one of us has) can readily perceive the truth of this statement. Yet those same internes are being trained on a urological service.

The urologist who is capable of doing the simpler laboratory tests himself, has an advantage over his colleague who, because he knows nothing of laboratory methods, sends his specimens to the commercial laboratory. The former often sees clinical truths in his specimens to which the latter is blind. But the former is not always the skilled technician who can employ method X and obtain the results that are claimed for it, although he may well be able to use successfully the methods that were taught in his early medical training. To this type of laboratory worker the results obtained by this study should appeal. It is an attempt to show that the simplest methods are better than the more complicated procedures.

We heartily endorse the idea of Watson who says in his excellent review of methods for demonstrating tubercle baclli in the urine: ". . . . in the examination of urine for tubercle bacilli, the method which requires the fewer laboratory reagents, consumes less time and gives a higher percentage of positive results is the one which will be used eventually."

As a rule, it is not difficult to find tubercle bacilli in a tuberculous urine by centrifugal methods. Perrson claims 78 per cent of positive results in proved cases of urinary tuberculosis; Rovsing 80 per cent and Ekehorn 80 to 90 per cent. But to do this one must not be misled by the often heard statement to the effect that the specific gravity of the tubercle bacillus is about the same as that of urine and therefore, like Ivory soap, "It floats." It is rather better to think of it as being heavier than most urines in which it occurs and that given half a chance, it will sink to the bottom.[1] That chance, when applied to centrifugalization, implies four chief factors, namely, the specific gravity of the urine (independent of the pus content), the amount of pus present, the length of time of centrifugalization and the speed with which it is done.

Our studies were begun with urines known to contain tubercle bacilli. But because of the difficulty of obtaining such specimens when most needed, we decided to produce artificial tuberculous urines. Since positive tuberculous sputa were relatively easy to be had (through the courtesy of the Bellevue Tuberculosis Service) we tried separating the tubercle bacilli by the antiformin method and adding them to urine. But this scheme soon proved unsatisfactory. Most of the sputa contained so few tubercle bacilli, that, when mixed with the relatively large amount of urine needed for each experiment, the time required to examine all the smears was entirely too long. Other more serious objections were the lack of uniformity of the tubercle bacilli content in the different urine specimens and the possible interference of antiformin in making a comparison of certain established methods.

[1] Dilg states that the Specific Gravity of the tubercle bacillus ranges between 1011 and 1076.

The scheme finally adopted was that of adding known amounts of a suspension of tubercle bacilli to measured amounts of urine. From a culture of tubercle bacilli, a suspension was made according to Corper's method by grinding the bacilli in a mortar and mixing them with equal parts of acetone and normal saline solution. It was found that 0.5 cc. of this suspension added to 300 cc. of urine (the amount needed for one experiment) would yield by any of the established methods for detecting tubercle bacilli in the urine, enough bacilli per smear to enable one to find them readily.

The experimental part of the work consisted in the examination of 26 specimens of urine and 2 of distilled water to which tubercle bacilli had been added. Thirteen of the urine specimens were grossly clear (except in some instances for a shred or two) and 13 were cloudy, the cloudy ones containing varying amounts of pus and bacteria, other than tubercle bacilli. The specific gravity ranged from 1000 (the distilled water) to 1026 in both groups (namely, the clear and the cloudy) and varied by 0002 points. Hence the specific gravity of experiment II was 1002, of no. III, 1004, and so on. In the "cloudy" group, a small amount of washed pus was added to the distilled water specimen. All specific gravities were estimated by the ordinary urinometer at room temperature.

Portions of each specimen (15 cc. each) were centrifugalized for four different periods of time, namely, five, ten, fifteen and thirty minutes at a so-called reduced speed (1700 revolutions per minute).[2] Then other portions of the same specimen were centrifugalized for the same length of time at high speed (2300 revolutions per minute). Thus each experiment necessitated the centrifugalizing of eight different equal portions of a specimen of a certain specific gravity.

[2] The speed of the centrifuge was determined by means of a centrifuge speedometer. Of course the centrifugal force varies directly with the speed and the diameter of the arm or cross piece from which the centrifuge tubes are suspended. The centrifuge we employed is Size I, Type C, made by the International Equipment Company, carrying eight 15 cc. tubes.

In a number of instances, we also made the sedimentation test for comparison. This consists simply in allowing the urine to stand for eighteen hours in a conical glass and making a smear from the resulting sediment. Ehrlich recommends twenty-four hours for sedimentation but we found that the supernatant fluid was entirely clear after eighteen hours had elapsed and hence adopted the eighteen-hour period as adequate.

The technique of making and staining the smears was as follows: The centrifuge tube is inverted and held upside down for about three seconds. It is then turned right side up. Urine will collect in the bottom of the tube above the sediment to the extent of one or two drops. With a pipette of very small calibre equipped with a rubber bulb, the sediment is drawn up and then expelled into the tube. This is repeated several times. A thin emulsion is the result. Enough of this emulsion is then placed on a slide to make an area of about 1.5 cm. in diameter and at least twice as thick as the average platinum loop smear. The smears are stained for three minutes with carbol fuchsin, heated until steam arises, and decolorized with 5 per cent sulphuric acid, rinsed with 95 alcohol and finally water.

In the clear specimen group (on account of the absence of pus) it was of course necessary to use some means of sticking the sediment to the slide. We tried egg albumin at first but had trouble in decolorizing the smears. A thin film of saliva answered the purpose admirably. Smears that proved to be too thick for proper decolorization were placed for five minutes in 5 per cent acid (HCl) alcohol as suggested by Simon who claims that it removes the urinary salts. They were then dried, fixed again in the flame and stained. Four minutes were given to the examination of each slide, the mechanical stage being employed to prevent covering the same ground more than once.

The charts give only a relatively accurate idea of the results obtained. The clumps varied in number of tubercle bacilli from two to several hundred. Hence precise enumeration was impossible. Suffice it to say, however, since it is not necessary to draw conclusions from them by splitting hairs, certain deductions may be made without reservation.

Specimens shown in chart 1 represent in a general way the curves of the findings of specimens below 1014 specific gravity, those on chart 2, specimens having a specific gravity above 1014. Hence only a few graphic representations are given as representative of the entire group.

Chart 1 shows the relative numbers of tubercle bacilli found in specimens of urine of low specific gravity and water to which

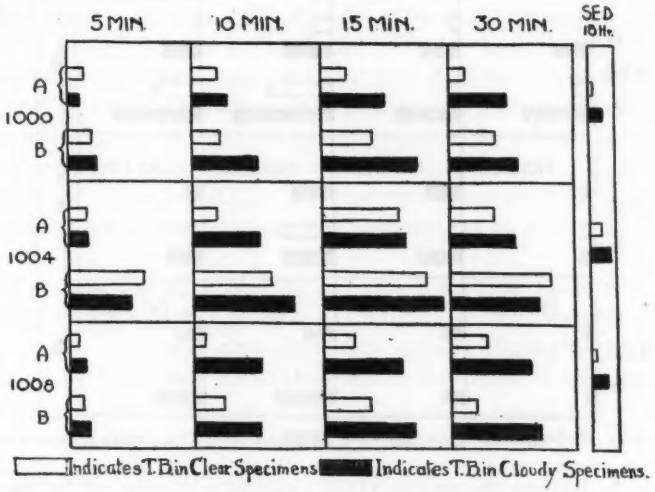

CHART 1. ILLUSTRATES THE RESULTS OF CENTRIFUGALIZATION AND SEDIMENTATION OF CLEAR AND PURULENT URINES OF LOW SPECIFIC GRAVITY (ALSO DISTILLED WATER) TO WHICH TUBERCLE BACILLI HAD BEEN ADDED

A and *B* represent centrifugal speed, *A* indicating reduced speed (1700 revolutions per minute) and *B*, high speed (2300 revolutions per minute). The figures on the left represent specific gravity and those at the top, periods of centrifugalization.

tubercle bacilli were added. Two of the urines are clear, two contain pus, one is distilled water and the other is distilled water to which a small quantity of washed pus was added. The clear oblong spaces and the dark spaces represent the relative numbers of tubercle bacilli that were found in the clear and cloudy (purulent) urines respectively. The figures at the left represent

specific gravity and those at the top, the periods of centrifugalization. *A* indicates reduced speed (1700 revolutions per minute) and *B* high speed (2300 revolutions per minute).

Chart 2 represents the findings in another series of six urines of relatively high specific gravity to which tubercle bacilli were

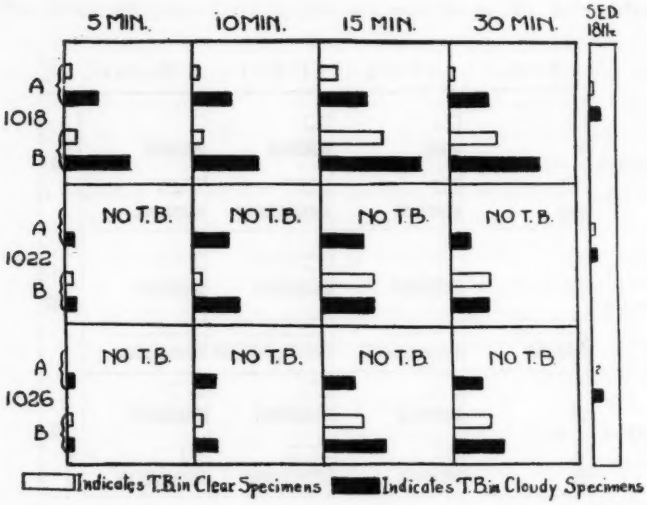

CHART 2. ILLUSTRATES THE RESULTS OF CENTRIFUGALIZATION AND SEDIMENTATION OF CLEAR AND PURULENT URINES OF HIGH SPECIFIC GRAVITY TO WHICH TUBERCLE BACILLI HAD BEEN ADDED

A and *B* represent centrifugal speed, *A* indicating reduced speed (1700 revolutions per minute) and *B*, high speed (2300 revolutions per minute). The figures on the left represent specific gravity and those at the top, periods of centrifugalization.

added. Three of the urines are clear, three contain pus. The clear and dark spaces, as in chart 1, represent the relative numbers of tubercle bacilli found in the clear and cloudy (purulent) urines, while the specific gravity, speed and periods of centrifugalization are indicated as in chart 1.

From the charts we may deduce the following:

Time of centrifugalization. Reading from left to right through-

out, on both charts (1 and 2) we see that best results are obtained with either reduced or high speed in the fifteen- and thirty-minute columns with the average in favor of fifteen.

Speed of centrifugalization in clear urines. In *clear* urines of low specific gravity, high speed gives better results than low speed (compare *A* and *B* (clear) in the five-, ten-, and fifteen-minute columns of specimens of specific gravities 1000, 1004, 1008 and even 1018, charts 1 and 2). In *clear* urines of still higher specific gravity high speed is absolutely essential (compare *A* and *B* (clear) in five-, ten-, fifteen- and thirty-minute columns of specimens of specific gravities 1022 and 1026, chart 2).

Speed of centrifugalization in cloudy urines. In cloudy urines, high speed gives better results than reduced speed as shown almost without exception in both charts. (Compare *A* and *B* (cloudy) in charts 1 and 2). The best results are more pronounced in specimens of very low specific gravity as in 1000 and 1004 (chart 1).

Clear and cloudy specimens. Almost without exception the cloudy (purulent) urines give strikingly better results than the clear. Compare *clear* and *dark* spaces, throughout charts 1 and 2. Differences are *less* marked in specimens of high specific gravity at high speed and *most* marked in specimens of high specific gravity at *reduced* speed. Again the differences between clear and cloudy urines are shown strikingly by the narrow column at the extreme right, namely, in the specimens which were merely allowed to stand in a conical glass for eighteen hours.

In some instances it is to be noted that specimens centrifugalized for thirty minutes showed somewhat poorer results than those centrifugalized at fifteen minutes at the same speed. We believe this to be accounted for by the fact that the sediment was so tightly packed in the bottom of the thirty-minute tube, that making the smear uniform with the other smears was difficult.

In selecting recognized methods of finding tubercle bacilli in the urine for comparison with simple centrifugalization, we chose those that represented groups of methods in which certain principles were involved. Thus Crabtree's method was selected because

it eliminates some of the pus in dense urine; the gasoline method of Kraus and Fleming because the specific gravity is raised by the addition of salt, thereby enabling one after centrifugalization to remove the tubercle bacilli from a thin layer of gasoline which rises to the top of the specimen; the antiformin as the simplest of the digestive methods which concentrate the bacilli;

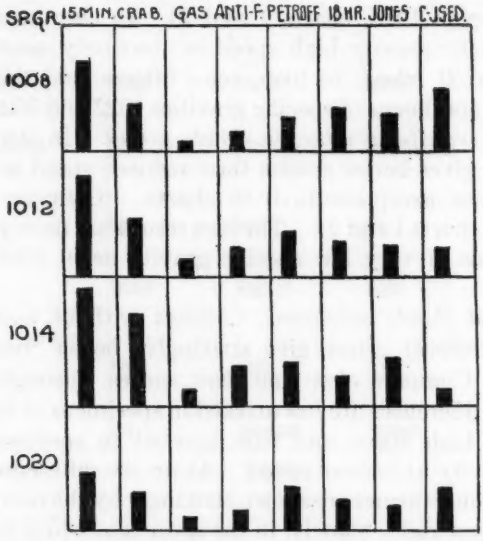

CHART 3. A COMPARISON OF THE RESULTS OBTAINED BY FIFTEEN-MINUTE HIGH SPEED CENTRIFUGALIZATION WITH OTHER METHODS

The specimens employed were purulent urines to which tubercle bacilli had been added.

Petroff's as one of the more complicated and time consuming methods in which the mixture to be examined must stand for twenty-four hours in the ice box before the final centrifugalization takes place; Jones' method in which the specific gravity of the urine is lowered by the addition of water and alcohol and finally, the simplest of all—the sedimentation method.

We employed the same clear and cloudy artificially produced

tuberculous specimens ranging in specific gravity from 1000 to 1026, for comparing our method with the above six different methods. But only the results of the cloudy specimens are charted as the six methods selected are intended chiefly for use in purulent urines. Only four specimens of different specific gravities are given on chart 3 to represent the entire group.

	15 MIN. CRABTREE	GASOLINE ANTIFORMIN	PETROFF	18 HR.	JONES	C. & J. SED.
1010	45 ± 15 7 9	14 ± 15	0	0	15 6 8	15 12 6 10	15 ± 55 ±	20 15 ± 4
1015	7 8	4	0	0	4	–	3 50	–
1015	4 4 3 6 15 ± 7	3 3 6	0	4 2	7 4 3	12 7 8	7 5 25	2 3 6 7 12
1015	3 7 5 30 ± 18 20	10 5 9	3	6 5	3 23 ±	7 12	7 6 10	12 7 9
1020	2 6 4 10 7 9 8	9 10 3 2	3	4 3	7 4 3	12 7 8	3 7 2 8	3 8 6 7
1025	10 3	2	2	0	5	–	3 8	–

CHART 4. A COMPARISON OF THE RESULTS OBTAINED BY FIFTEEN-MINUTE HIGH SPEED CENTRIFUGALIZATION WITH OTHER METHODS

Actual tuberculous urines were employed. The figures within the rectangular spaces represent the number of tubercle bacilli per clump. The figures on the extreme left represent specific gravity.

Finally we examined a series of six actual tuberculous urines as follows: Portions of the specimens were cenrifugalized for five, ten, fifteen and thirty minutes at reduced and high speed. Other portions were examined for tubercle bacilli by the six methods mentioned. In both series of tests which are represented by charts 3 and 4, smears were also made from the sediments obtained by the preliminary centrifugalization (the part

ordinarily discarded) of the Crabtree and Jones' methods. The number of bacilli found is represented in the columns designated as "C. & J. Sed." To produce uniform smears for comparison, we found it necessary in the method of Crabtree and also that of Jones to alter somewhat their technique in making the smears. That is, instead of using a platinum loop to transfer the sediment in the bottom of the centrifuge tube to the glass slide, we employed a pipette of small calibre as described in the foregoing. We apologize for taking such liberties with their methods but found the slightly modified technique was not detrimental to either.

Since our fifteen-minute high speed method gave the best results of the simple centrifugalization tests, the results of this series only (shown in the column labelled "15 min.") are given on charts 3 and 4 in comparison with the other methods. However, in fairness to Jones' method, attention should be called to the fact that these graphic representations and figures are based on smears made from only 7.5 cc. of urine centrifugalized, as the other 7.5 cc. consists of alcohol and water. Theoretically, therefore, if the entire 15 cc. of material in the centrifuge tube consisted entirely of tuberculous urine as in the other specimens, his figures would be doubled.

Chart 3 requires but little explanation. One readily sees that, as a rule, the fifteen minute high speed specimens produced the greatest number of tubercle bacilli of any method. It is likewise of interest to note that in some instances, the sediments obtained by the preliminary centrifugalization employed in either Crabtree or Jones' method (the part to be discarded) gave better results than the final smears.

In chart 4, where actual tuberculous urines were employed, in the majority of the specimens the bacilli were so few in number compared to those in the artificially prepared specimens, that a more accurate estimation could be made. Hence actual figures instead of graphic pictures are used to indicate the number of tubercle bacilli found. Tests were not made where the hyphens appear. The results are much the same as those shown in chart 3.

The more we saw of the different forms and sizes which tubercle

bacilli may assume, the more convinced we were that Corper's idea of a comparative stain which he employs in the examination of sputum, is an excellent one. He makes a smear from known tubercle bacilli on the slide along with the unknown smear. In fact, from our studies, we feel justified in suggesting the following plan for coincident staining in urines: Balance the unknown specimen in the centrifuge with a tube of the same urine to which tubercle bacilli from the stock suspension (which keeps well) have been added. A smear from each specimen should be made on the same slide far enough apart to avoid contaminating each other. This method would serve not only as a control for morphological characteristics and staining properties of the bacilli but also help to rule out any flaw in the technique of centrifugalization itself.

Corper also mentions another point, which we have observed and which we think should be emphasized. Referring to the Ziehl-Neelsen method of staining, he says, "the preparations by this method are also not permanent—the bacilli gradually becoming paler." It would behoove one therefore to examine smears as soon as possible after staining and not set them aside for any length of time.

In conclusion it seems appropriate to mention that since animal inoculation, the greatest time consumer of all seems to have lost some of its former prestige, there is an added reason why we should adopt the simplest possible procedure of identifying tubercle bacilli directly from the urine.

For their kind coöperation in furnishing specimens, we wish to thank the Staffs of the Bellevue Urological Service, the New York Hospital Urological service, St. Mark's Hospital Urological Service and the Urological Department of the Cornell Clinic.

CONCLUSIONS

1. In examining any type of urine for tubercle bacilli by centrifugal methods, the best results are obtained when the specimen is centrifugalized for a period of not less than fifteen minutes at a speed of approximately 2300 revolutions per minute. A longer period than fifteen minutes is apparently unnecessary.

2. Pus is an important factor, as well as centrifugal force, in carrying down tubercle bacilli. According to certain established methods, should part of the pus be removed in order to produce better smears, then the pus removed should be examined for tubercle bacilli as well as the final sediment.

3. Coincident centrifugalization of part of the unknown specimen to which tubercle bacilli from a stock suspension have been added, and subsequent coincident staining of both smears on the same slide, is advisable.

4. Simple centrifugalization as a means of finding tubercle bacilli in the urine is, in our experience, equal to any established method and better than most of them. It would therefore seem to be the most satisfactory method for the urologist who does his own laboratory work or who has it done under his own supervision.

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DISCUSSION

Dr. WILLIAM A. FRONTZ (Baltimore): In connection with Dr. Jeck's paper, I should like to call attention to an article published in the June issue of the Journal of Urology. This article is by Elvers, and describes the technic for the staining of tubercle bacilli whereby it is unnecessary to heat the specimen. The technic is apparently very simple. It involves only staining for a few minutes. The acid-fast organisms are very sharply and deeply stained. Other organisms, the non-acid-fast, stain beautifully, as do the cells and nuclei in the sediment. From the work that has been done it would seem, too, that this stain will be of value in tissue staining. I can not give you the exact stain that is used. The technic of making it up, and so forth, will be described in the article.

Dr. FRANCIS R. HAGNER (Washington, D. C.): I would just like to make a remark concerning a case which we recently had. It is a little foreign to Dr. Jeck's paper. It was the case of a young woman with perfectly clear urine, with her urine just sparkling clear both from the bladder and from the kidney. The only suspicious thing she had was two little spots in the region of the ureter that was affected. The specimen that was obtained was centrifugalized and branching forms of tubercle bacilli were seen just as we see in sputum at times. She was operated upon and a perfectly normal-appearing kidney removed, and on section after it was taken out one papilla had an area of tuberculosis.

Dr. E. GRANVILLE CRABTREE (Boston): I want to compliment Dr. Jeck on the very careful and very instructive bit of work on the finding of tubercle bacilli which he has reported. I think Dr. Jones and I are perfectly content to be runners-up. He has crossed the bar above us.

I do think in relation to the partial centrifugalization it has been occasionally found that clumps of bacilli will come down in that effort at removal of gross pus. It is often worth while to remove it in order to hunt more carefully over the remainder of the urine, which is more profitable in most cases.

It has seemed to me, as I worked with tubercle bacilli, that the difficult case for diagnosis is the tuberculous pyonephrosis. In thinking back over the data which led to the publication of my paper, it was the increased success in finding bacilli in large quantities of pus that led me to depend upon the method which I described more than any other method then known. Dr. Jeck's method, however, shows a high percentage of finds, a higher percentage than any of us have been able to obtain and we shall all be glad to try it.

Dr. GILBERT J. THOMAS (Minneapolis): I am very much interested in the subject of renal tuberculosis. Each year our staff has occasion to examine about 4000 urine specimens for tuberculosis. Primarily this is done by the so-called Ziel-Nielson method of staining. Dr. Jeck's method is really an advance in the method of finding tubercle bacilli. Last year we injected some 700 guinea pigs, which was quite an expense and a big job, and of course, it took six weeks before we knew whether the patient had tuberculosis or not.

I want to compliment the doctor on this method of determining tubercle bacilli and I certainly will take occasion to use it in my future work.

Dr. ALEXANDER RANDALL (Philadelphia) (closing): Dr. Keyes voiced his discussion in private when he said he did not believe that this patient was free of some intestinal fistulization. As far as possibly could be determined at operation, this was not the case, and in the subsequent healing up of the wound, I think it proves that there was none.

The interest lies in the fact that there are only six cases in the literature and in only one case—that published by McCallum and Kelley—was gas observed cystoscopically. From the fact

that colon bacilli were obtained at operation, the question immediately arises how gas could, or would be, formed under such conditions, and the peculiar point in this instance, is that apparently this colon bacillus had acquired the ability of gas production which was lost subsequently in laboratory sub-culture; I think in about ten sub-cultures it had lost its gas-producing factor, but it should be borne in mind that that can occur.

Dr. HOWARD S. JECK (New York City) (closing): I want to thank the Society for their kind discussion. I must confess I suffered a little stage-fright when I saw that Dr. Crabtree was present. I also want to thank the Society for the privilege of presenting my paper before them.

PNEUMOPYONEPHROSIS WITH PNEUMATURIA

REPORT OF A CASE[1]

ALEXANDER RANDALL

Pneumaturia, while itself a rare condition, has been observed frequently enough to make it a fairly well-known clinical phenomenon. A review of the literature yields 31 undoubted cases. The gas usually arises by fermentation in the bladder or reaches it through a vesico-intestinal fistula. Gas in the ureters, renal pelves and kidneys is very rare: it has been described in only 6 cases. This case of pneumopyonephrosis with pneumaturia is unique in that the presence of gas in the kidney was diagnosed by x-ray and confirmed at operation.

CASE HISTORY

Freda S., a Jewess, forty-four years old, was admitted on September 25, 1923, to the Medical Division of the Hospital of the University of Pennsylvania, with a chief complaint of pain in the left flank, radiating to the thigh. Her illness began fifteen years before, with pain in the bladder, and urgency and frequency of micturition. Soon after the onset there developed a dull pain in the right flank. Symptoms continued without intermission up to the time she entered the hospital, although they at no time completely incapacitated the patient, nor did she ever notice much fever. She was treated more or less constantly by internal medication. The first local procedure was undertaken in 1920 by a physician in another city, who performed a cystoscopy, catheterized both ureters and had an x-ray examination of the kidneys made. Details of the findings she could not give, but she was told that she had a "pus kidney" on the left side (not on the right where the pain

[1] This case is reported through the courtesy of Dr. Richard A. Kern and Dr. Eugene Prendergast who expect to report it *in extenso* with the literature of the subject at an early date.

was) and was advised to have an operation. This she refused to do and shortly afterwards came to Philadelphia.

Symptoms continued unchanged until 1922 when she developed an acute febrile attack with pain in the lower part of the left chest, left flank and loin space. The condition was diagnosed pneumonia and lasted several weeks. During the illness the pain on the right side disappeared and has not recurred. The bladder pain, urgency and frequency (the latter worse at night with ten or twelve voidings) continued as did pain in the left flank with some radiation into the left thigh and iliac region. The urine was constantly quite cloudy and on several occasions over a period of years has contained shreds of blood clot. For several years there was a slight morning cough productive of a little thick sputum.

There were no symptoms referable to other organs except some discomfort if she ate heavily. Her nutrition continued unimpaired until the last year before coming to the hospital: during this time she thought she lost about 15 pounds in weight. The menses were always rather irregular but never painful or excessive.

Her health previously was always good. One of eight pregnancies miscarried. Two children died in infancy, while five are living and well, the youngest being ten years old. An umbilical hernia developed in the course of a labor twenty-two years ago. The social and family history were negative.

Physical examination showed the patient to be in a good state of nutrition, a little inclined to obesity. There was no adenopathy and the reflexes including those of the pupils were normal. There were several crowned teeth and some unextracted exposed roots. The chest was somewhat asymmetric because of a moderate scoliosis. A careful examination of the lungs was entirely negative. Heart and superficial vessels were normal and two blood pressure readings were 110/65 and 110/56.

The chief findings were in the abdomen. Occupying its upper left portion, was a fixed, large, tender, vaguely defined mass the size of a grapefruit, probably the left kidney. Pressure over the mass caused pain that radiated to the bladder. There was a small reducible umbilical hernia. The pulse was a bit hurried with a rate of 80 to 100. The temperature was very little elevated, once in ten days reaching 99.8°F., while the rest of the time it ranged between 98 and 99.4°.

Urinalysis. The urine on repeated examinations was cloudy with a heavy precipitate, had an acid reaction and contained from traces to a

cloud of albumin. At no time was sugar found. The urinary sediment was loaded with pus cells and at times a few erythrocytes were found. Smears of the sediment showed no tubercle bacilli and a guinea-pig inoculation likewise failed to demonstrate them. Urine culture findings will be referred to below. Two phenolsulphonephthalein tests gave a two-hour dye elimination of 17 and 23 per cent respectively. The blood urea nitrogen was 17 mgm. and uric acid 3.0 mgm. per 100 cc. There was a slight anemia (4 million red blood cells, 77 per cent hemoglobin) and a normal leucocyte count (6300) with normal differential. The blood Wassermann was negative.

Cystoscopy. Cystoscopy by Dr. F. E. Keene showed the bladder capacity reduced to 2 ounces. The fundus presented two very superficial areas of ulceration. The right ureteral orifice was normal in appearance but the left was ulcerated and rigid and creamy pus could be seen exuding from it. No tubercles were found. Indigocarmine injected intramuscularly did not appear from either side in twenty minutes. The right ureter was catheterized and the specimen collected appeared clear, but the microscopic examination showed a few clumps of pus cells and a few hyaline casts.

On vaginal examination the left ureter was felt greatly thickened and nodular, a typical "rosary" ureter. The right ureter was not palpable.

A diagnosis was made by Dr. Keene on these findings of tuberculous pyonephrosis with complete destruction of the left kidney and a tuberculous ureteritis (left), and probably very early tuberculosis of the right kidney. Left nephrectomy was advised.

X-ray examination. X-ray examination of the urinary tract gave a surprising result. After the x-ray films were seen, the symptom of pneumaturia was inquired into, whereupon the patient told what before she had suppressed out of modesty: that for about two years she had been constantly passing gas by urethra, usually at the end of urination, with an audible, at times loud sound, sometimes like that of flatus by bowel. This was never painful, the gas was odorless, and at no time did the patient notice any solid matter (feces) in the urine. (X-ray films were shown illustrating condition found.)

Operation. On October 6, 1923, the patient was operated upon by Dr. Keene. The left kidney was found greatly enlarged, and fixed by adhesions to the surrounding structures. Through a needle the kidney was aspirated and a fair sample of gas collected under oil. Analysis showed no hydrosulphide; CO_2, 10 per cent. Culture taken at operation showed B. coli communis and pyocyaneus. A pig inoculated from pus

obtained at operation was negative for tuberculosis. The kidney was then opened. It consisted of a mere shell of fibrous tissue, containing some gas and a large quantity of creamy yellow pus with a pronounced odor suggesting colon bacillus infection. Pelvis and upper ureter were greatly dilated. Of renal tissue nothing could be found. Because of the extensive adhesions the kidney could not be removed, and drainage alone had to suffice. No evidence of any connection between the urinary tract and the intestine could be found.

She made a good immediate recovery from the operation, but has continued to have a sinus discharging a yellow, at times greenish, tinged pus. For a time the pneumaturia continued, with also escape of gas from the sinus, growing gradually less and finally stopping about ten months after operation. The urine continued cloudy, acid in reaction, containing always considerable pus. For the most part she has had no fever: only when the drainage from the loin sinus stops does she have some elevation of temperature and subjective discomfort. A rather marked attack of this kind occurred in January, 1925, with pain suggesting a pleurisy. Physical examination, however, showed nothing beyond fixation of the diaphragm (adhesions) and this was confirmed by fluoroscopy. X-ray examinations of the lungs continue to be negative for any evidence of pulmonary disease. The patient's general health and nutrition have continued fairly stationary at a rather good level. Her weight which was 130 pounds in September, 1923, was 138½ pounds on January 5, 1925.

It is of interest to note that the laboratory studies of the B. coli communis which was cultured from the kidney at operation possessed the ability to produce gas in culture media for several subcultures and then lost the same completely.

A FURTHER REPORT ON THE PROSTATIC HEMOSTAT

W. W. TOWNSEND

This instrument consists of a sound with a rather long curve. After the prostate has been enucleated, this is passed down through the urethra, pressed between the thighs, and this little olivary tip removed. This larger bulb is taken out of a pitcher of hot water; not so hot that you cannot hold the bulb in your gloved hand. This sound is pulled out and this bulb occupies the space that was occupied by the prostate in the prostatic capsule. The symphysis acts as a fulcrum and pressure is made here. The instrument is held in that position for a period of about five minutes. That is an arbitrary period of time. It might be kept in there and hemorrhage be arrested in three minutes, but we have always used a period of five minutes.

It is my wish to make a further report on the use of the hemostat, which we devised, to be employed following suprapubic prostatectomy.

Since demonstrating this instrument at the last meeting of this Society but one change has been made. It may be remembered that the instrument was fusiform in shape. It has been remodeled so that now the posterior surface is broader than the anterior, while the anterior is concave rather than convex. This simply allows for an easier delivery from the bladder.

The hemostat, since it was shown last year, has been used in our Clinic in 34 cases of prostatism, classified as follows: 7 typical cases of median bar or vesical neck contraction, 3 cases of frank carcinoma and 24 cases of prostatic adenoma. In the last group in which a clean dissection of the gland was accomplished the hemostat was the sole means of controlling hemorrhage. In not a single instance was there the slightest bit of primary hemorrhage, and in but one case secondary hemorrhage and that ten days following the prostatectomy. This event, I do not consider,

can honorably be charged against the instrument. The group of carcinoma, though small, are more interesting. These patients were operated upon for the single purpose of affording drainage and in each instance only small bits of the gland could be removed. In 2 cases the hemostat controlled the hemorrhage excellently, but in the third gauze packing had to be resorted to. The explanation of the failure is simple. The solid body of the instrument could not sufficiently compress the hard carcinomatous mass to reach all the small bleeding points. In the contracture cases we employ Young's punch combined with a cystotomy, which not only affords the primary drainage but allows the index finger to guide the cutting edge. In these 7 patients the hemostat worked as efficiently as in the simple adenoma. There was a complete hemostasis in each case.

Therefore, I again contend that this instrument, in our hands, has solved the problem of hemostasis following suprapubic prostatectomy for the following reasons: first, there is an immediate arrest of the hemorrhage; second, there is nothing left in the bladder to be removed some hours later to the discomfort of the patient and the surgeon, or interne; and third, there remains a smooth prostatic bed free from tags.

[At the conclusion of his paper, Dr. Townsend said:]

I might add that after the instrument is taken out, the bladder is closed around a small tube, the size of my little finger. That tube is left in about two or three days, and then removed and a new indwelling catheter put in. You take a soft rubber catheter 20 to 24 F. and pass it into the bladder without any trouble whatsoever.

DISCUSSION

Dr. QUINBY: To what temperature is the hemostat heated?

Dr. TOWNSEND: This hemostat is boiled separately from the other instruments and it is brought out in a pitcher and remains on the instrument table until after the enucleation, and is then taken out of this pitcher so that it is much below boiling and you can hold it in your hand very comfortably.

Dr. QUINBY: In a gloved hand?

Dr. TOWNSEND: In a gloved hand. I should be able to tell you just exactly the temperature, but I can not. It is just simply a hot piece of steel.

Dr. VERNE C. HUNT (Rochester, Minn.): I think that we are very much indebted to Dr. Randall for his presentation. So far as I know, there is no one who has made as careful a study of the various types of prostatic enlargement of a surgical nature as Dr. Randall has. I think we all have had the pleasure of looking over his collection of specimens that he has at the hospital on his service, which I think have been on display before at several of the meetings (I think at the American Medical Association several years ago) and to my knowledge it is the finest display to emphasize the various types of prostatic enlargements that are observed. I think Dr. Randall has presented here only a few of the types which his collection will show.

There has really been a great deal of difference of opinion regarding the site in which prostatic enlargement occurs; in the tissues with reference to the stroma or to the glandular elements, and as to the classification, the lateral and median lobes, and so on. I think probably we are all practically in agreement

with what Dr. Randall has said about the origin of prostatic enlargement or that hypertrophy may occur in any and all parts of the gland with the exception of probably the posterior lobe.

I do not wish to discuss some of the points which Dr. Randall has brought up, because they have to do largely with the observations that are made on cystoscopic examination. However, I want to express, personally, my appreciation to Dr. Randall for this very excellent presentation.

The subject of hemostasis after prostatectomy is always a very interesting one and I think that hemorrhage—operative and postoperative—is one of the most important factors in prostatic surgery. This is the first time that I have seen Dr. Townsend's instrument. It is a very interesting device to me. I would just like to ask a question as to what the actual control of hemorrhage is by use of the instrument; that is, how soon after prostatectomy, may I ask, does the urine clear up and show the absence of gross blood?

Dr. Henry H. Morton (Brooklyn): Dr. Randall's paper has been very helpful to me in clearing up the pathology of the hypertrophied prostate. In 1924 I spent some months in the laboratory of Prof. Bauer, in Vienna, doing some microscopical work in connection with the genito-urinary tract, and we spent a good deal of time in cutting and examining sections of hypertrophied prostates. Of course, the theory of Tandler and Zukerkandl originated in Vienna, and was generally accepted by the Viennese School as well as the rest of us. Stated briefly, it is the idea that the hypertrophy begins in the subcervical gland or glands of Albarran, which grow down and spread out the original prostatic substance at the sides and at the periphery, making a sort of a capsule of the original prostatic substance. We expected to find in our microscopical examinations the hypertrophy in the center of the gland and the prostatic tissue at the periphery. We did not find anything of that sort. We found a hyperplasia of the musculatures and glands distributed through the entire substance of the hypertrophied prostate. We could not make our findings agree with the theory as put down in the books, and we were uncertain about it.

Now Dr. Randall's explanation of the hypertrophy taking place in certain groups of glands and the direction of growth depending upon the glands that are affected, has cleared up this whole subject for me and fits in entirely with the findings which we made there in Dr. Bauer's laboratory. I am very much obliged to Dr. Randall for his demonstration.

Dr. WILLIAM W. TOWNSEND (Burlington, Vt.) (closing): I have nothing to add except to answer Dr. Hunt's question and that is that the urinary secretion will run pink from twenty-four to forty-eight hours, but we never have had any hemorrhage that was alarming after the use of the instrument.

THE CLINICAL ASPECTS OF URETERO-VAGINAL FISTULA

J. DELLINGER BARNEY

Boston, Massachusetts

While it is believed that the case about to be reported is one of uretero-vaginal fistula, there are certain features of it which make such a diagnosis impossible of confirmation. Hence, it might have been wiser to describe it as a case of vaginal urinary fistula. While in its course, symptomatology and certain other respects it differs not at all from the uretero-vaginal fistulae which sometimes follow abdominal hysterectomy (especially those for malignant disease) it is unique in that it dates from a confinement and also that it has been attended with the formation of calculi.

The patient, Mrs. M., forty-nine years old, was referred to me in October, 1926. Aside from minor ailments the patient had always been well, her chief and only complaint being a leakage of urine from the vagina. Strangely enough the patient could not give a very connected story of this trouble. She was confined about twenty years ago and forceps were used in the delivery of the child. It is not clear that the labor was extraordinary either for its difficulty or length. It is probable, however, that it was badly managed. Convalescence was evidently smooth enough except that the patient had to be catheterized two or three times and to this circumstance she ascribes her present trouble. At any rate, shortly after this urine began to leak from the vagina. The patient does not remember that this continued but thinks it stopped after a while. Fifteen months later she was again confined and following this leakage of urine from the vagina recurred together with the "formation of a sac with stones in it" to quote the patient's own words. From this time on the patient is definite in her statement that there has been a more or less constant leakage of urine from the vagina.

A third confinement occurred fifteen years ago and at this time she was operated upon in the Women's Hospital in New York City where three stones were removed from a "pocket" in the vagina. Before the

removal of theses tones there was considerable discomfort and pain in the vagina and rectum. After their removal the patient was entirely comfortable except for the incontinence.

In July, 1926, realizing from her previous experience that calculi must have reformed the patient consulted her doctor. He removed two stones each about the size of a silver quarter which were "imbedded between the vagina and the rectum." She was in the hospital for two weeks. After leaving there the pain in the vagina recurred and examination showed another stone still remaining.

The patient stated that the incontinence, although constant, is quite variable. Some days there is practically none; on other occasions, especially when she is tired or excited she will leak enough to wet three napkins per day. Posture, apparently, does not influence the incontinence although it is perhaps a little less when she is lying or sitting down. Normal urination occurs every hour or two by day and occasionally once at night. There is no dysuria or urgency and nothing abnormal has been noted in the urine. The patient's general health is excellent and in spite of her incontinence she enjoys life.

Physical examination showed a healthy-looking, rather stout woman. Aside from the local conditions to be described nothing abnormal was found. Abdominal examination showed no mass or tenderness; neither kidney was palpable. Pelvic examination showed urine leaking from the vagina. On the left vaginal wall, close to the cervix there was felt a firm, somewhat elevated, very tender area. The uterus was fairly movable, retroverted, not large or tender. In the left cul-de sac there was definite thickening with slight tenderness. A speculum in the vagina showed a fistulous opening on the left wall, about 3 cm. from the cervix. This opening was partially filled by a white, fairly hard stone and from it urine leaked freely. Attempts to move the stone produced great pain. The cervix itself presented a bilateral laceration but neither it nor the adjacent vaginal wall showed evidences of any extensive scar formation.

Cystoscopy showed an entirely normal trigone and ureters. There was no evidence of supernumerary ureteric orifices or of a fistulous opening. The mucosa was normal everywhere.

The bladder was filled with 150 cc. of dark methylene-blue boric acid solution. A speculum was then placed in the vagina and the fistula observed carefully for the space of fifteen or twenty minutes. During this time urine leaked freely from the fistula but it contained not a trace of blue.

FIG. 1. URETERO-PYELOGRAM OF LEFT SIDE SHOWING CALCULUS IN VAGINAL SINUS (*A*) AND FISTULOUS TRACT LATERAL TO URETER (*B*)

Number 6 catheters were then passed easily the full distance to each kidney with a normal flow of clear urine from each. The sediment of

these and the bladder urine showed only an occasional leucocyte. A left pyelogram and ureterogram were made (fig. 1). The roentgenologist, Dr. George W. Holmes, reported in summary as follows:

The kidney outlines appear to be normal in size, shape and position. Low in the pelvis, just to the left of the median line a little above the pubic arch there is an irregular shadow of increased density about 2.5 by 1.5 cm. This area is well outside the course of the ureter. The injected pelvis of the left kidney appears normal in size and shape. There is a ribbon-like shadow of increased density which extends from the lower portion of the left ureter upward along the course of the ureter as high as the upper portion of the sacrum, dipping down into the pelvis and communicating with the shadow already described. Dr. Holmes then concluded that,

"The appearance is probably due to an anatomical variation—bifid ureter which communicates with kidney substance in the true pelvis."

The situation was fully explained to the patient and she was told that in my opinion she had a uretero-vaginal fistula resulting from an obstetrical injury; that there was a possibility that this could be cured by anastomosing the ureter to the bladder and that the stone in the vaginal sinus could be removed at the same time. The patient accepted my suggestion of operation rather reluctantly.

Operation was performed October 18, 1926. A preliminary cystoscopy was done and a No. 6 catheter passed up the left ureter. At the same time the stone was removed from the vaginal sinus. This was easily done by the aid of forceps and a curette. The stone was white, hard and about the size and shape of an almond. A careful exploration of the cavity from which it came failed to find any other opening than that into the vagina. A median suprapubic extraperitoneal incision was then made and the left ureter with its inlying catheter exposed just below the pelvic brim. The ureter did not appear to be dilated, thickened or particularly adherent. However, as it was followed downward into the depths of the pelvis, a mass of dense scar tissue was encountered and in this the ureter was so firmly embedded that it did not seem possible to isolate it. It seemed quite probable either that the ureter would be torn off or that it would have to be divided at a point so far from the bladder that its anastomosis to that organ would be impossible. Careful search was made for any aberrant vessels or bifurcated ureter or other abnormality which would throw light on the problem but nothing was found. It was, therefore, decided to go no further as the only alternative seemed to be to do a left nephrectomy

and this did not seem to be justifiable in view of the perfectly normal condition of the kidney. Moreover, as I shall show later, there had arisen doubts in my mind as to whether, after all, I was dealing with a uretero-vaginal fistula. Accordingly, the wound was closed in layers around a cigarette drain.

Convalescence was normal except for the development of a very marked cystitis of several days duration. The urine which before operation had been practically normal became thick with pus and mucus, together with a few red blood cells. A few days of constant drainage with an indwelling catheter and frequent hot boric acid irrigations put an end to the process and the patient left the hospital three weeks after operation no worse because of the operation and more comfortable because of the removal of the stone.

As a result of my examinations and the operation I concluded that I was probably dealing with a fistula of the lower end of the left ureter connecting with the vagina, either directly or by means of a sinus in the pelvic cellular tissue. In view of the ease with which a catheter passed up the ureter to the kidney and of the absence of a stricture or of any abnormality in the course of the ureter I further concluded that the fistula did not involve the entire lumen of the ureter but was rather in the nature of a lateral opening. On the other hand any injury to the ureter, whether it involve all or only a portion of its lumen, especially if it arises from a laceration or necrosis, is almost invariably followed by stricture, infection of the ureter and kidney and pyonephrosis. In this case the urine from the left kidney was uninfected and normal and the pelvis not at all dilated.

While in retrospect I have thought of various other examinations and tests which I might have made to get at the facts these were not carried out, partly because they did not occur to me at the time, and partly because of the patient's reluctance to have anything done except the removal of the calculus. On the other hand, I feel certain of the accuracy of those observations which I did make. It seems to me that the failure of a deep blue solution in the bladder to leak from the fistula definitely rules out the the possibility of a vesico-vaginal fistula of unusual character and course. Granting this we must then be dealing with a fistula either from a supernumerary pelvic kidney, or from the ureter.

An inquiry among my urological colleagues as well as among obstetricians, gynecologists and general surgeons has failed to reveal any similar case in their experience. A review of the literature has yielded equally unsatisfactory information. As regards supernumerary kidney Young (Practice of Urology, Saunders, 1926) says: "Free supernumerary kidney is one of the rarest of renal anomalies and the reports of cases in the literature are relatively few. As the condition may be entirely symptomless the majority of cases have been found at autopsy. Isaya collected 10 cases found at autopsy and 5 which were diagnosed during operation. To the latter he added one case of his own observation." Young cites 2 more cases reported by other writers, making but 18 in all. These are the only cases of supernumerary kidney to which I have found reference and none of them seem to have been located in the pelvis.

Furthermore, it seems probable that in a thorough exploration of the deep pelvis on the left side I would have come across evidences of such a kidney either in the way of aberrant blood vessels or a bifid ureter. While the possibility of this diagnosis cannot be entirely excluded it is extremely improbable.

Morris (Surgical Diseases of the Kidney and Ureter, II) is the only author I have found who has discussed the subject of ureterovaginal fistula resulting from obstetrical injury. It is unfortunate, however, that he gives no case reports. He says: "A very frequent cause of traumatic ureteral fistula is the sloughing of the soft tissues following prolonged and difficult labor." These fistulae "affect that portion of the ureter between the neck of the uterus and the vesical orifice of the ureter." He recalls the fact that the "vesical orifice of the ureter is situated about 3 cm. below the os uteri externum and compression of the part of the bladder through which the ureter passes, between the foetal head and the pubes will produce either a uretero-uterine or a ureterovaginal fistula, according as the slough which results is on a level with the uterine neck or lower down on the vaginal wall. Fistulae caused in this way are, however, much more frequently vesicovaginal than uretero-vaginal and uretero-vaginal are much more frequent than uretero-uterine."

On the other hand T. A. Emmet (quoted by Morris) thought that uretero-vaginal fistula was never the direct result of childbirth but was always due to pelvic suppuration. He says "the ureter can scarcely communicate directly with the vagina as a result of childbirth" because the ureters have no direct connection with the sides of the vagina but only an indirect one through the connective tissue of the pelvis. When the ureter leaks into the cul-de-sac behind the cervix the lesion is, in Emmet's opinion, always connected with an attack of cellulitis and this cellulitis must terminate in an abscess in order to bring about a uretero-vaginal fistula. The abscess drags the ureter upward to the point where it becomes bent at an angle and the passage of urine into the bladder being partially obstructed leads to inflammation and ulceration and ultimately to a fistula. While Morris thinks that Emmet's explanation is correct for many of the cases, he does not doubt that in others the fistulae result directly from pressure on the sides of the middle third of the vagina in juxtaposition with which the ureters course their way to enter the substance of the vesical wall. Uretero-vaginal fistulae involve (1-the ureter anywhere between the broad ligament and its termination in the bladder and (2) the dome of the vagina or the upper third of the anterior and antero-lateral wall behind the base of the so-called "vaginal trigone of Pawlik."

According to Morris the orifice of a true uretero-vaginal fistula is often very small, and may be situated upon a minute mass of granulations or hidden from view behind a band of cicatricial tissue. In the majority of cases the orifice of the fistula is the ureter itself which has become incorporated with the cicatricial tissues but in some instances when there has been a loss of an inch or two of the tube the opening is not directly into the vagina but into the uretero-peritoneal connective tissue space, from which a fistulous connection leads into the vagina.

In addition to childbirth Morris says that the prolonged use of a pessary has sometimes been the cause of uretero-vaginal fistulae.

An extensive review of the literature shows no case similar to the one just reported, namely, uretero-vaginal fistula with cal-

culus formation. The following are the only ones which are at all similar. Hahn (Zentralbl. f. Gynäk., 45: June, 25, 1921) reports a case of utero-vaginal fistula with two large calculi in the uterus. This followed a difficult forceps delivery twenty years before. Kneise (Zentralbl. f. Gynäk., 47: 594, April 14, 1923) reports a case of utero-uretero-vaginal fistula occurring eight days after forceps delivery.

Bullock (Med. Jour. Australia, ii: 709, 1922) reports a case wherein following difficult labor the cervix was found to be cut off completely from the vagina, the uterine canal obliterated and the lower end of the right ureter entirely destroyed. Urine had apparently leaked into the perivesical tissues. Weinzierl (Monatschr. f. Geburtsh. u. Gynäk., 65: 193, January, 1924) reports 2 cases of uretero-vaginal fistula resulting from the pressure of a pessary.

As regards the symptomatology Morris says that the attitude of the patient does not affect the escape of urine from a ureteral fistula. In ureteral cases no matter whether the woman is lying on her back, or side or abdomen, whether she is sitting or standing the urine escapes from the vagina just the same (as it did in my patient). This is not necessarily the case in vesico-uterine or vesico-vaginal fistulae.

It is also of interest to recall the fact that the first nephrectomy was performed by Simon in 1869, and that it was done for the cure of a traumatic fistula of the ureter opening just above the pubes.

It is obvious to us of today that the treatment of a ureterovaginal fistula consists of an anastomosis of the ureter and bladder if the condition of the kidney and the proximity of the fistula to the bladder warrants such a procedure. In certain cases, however, nephrectomy will be the only way out of the difficulty. It is obvious also that owing to the likelihood of infection and of the formation of scar tissue any attempts at repair should be made at the earliest possible moment.

In closing it seems appropriate to congratulate the obstetrician for developing his art to such a point that the injuries which Morris speaks of as common in his day and at an earlier time are now virtually unknown.

BILATERAL DIVERTICULA OF THE URETER

CASE REPORT

N. P. RATHBUN

From the Urological Service of the Brooklyn Hospital

A casual survey of the literature would lead one to believe that diverticula of the ureter are among the very rare forms of pathology noted in the urinary tract. A. R. Stevens reported a case before this society one year ago and at that time reviewed the literature. He found only two other clinical cases reported. One case reported by Neff occurred in a man thirty-two years of age who gave a history of repeated attacks of renal colic. At operation a diverticula 13 cm. long and 2 cm. in diameter was found about 8 cm. above the bladder, which was removed with relief of symptoms. Another case was reported by Hale and von Geldern of a small diverticula located about 10 cm. above the bladder in a man twenty-seven years of age who had suffered from pain in the lower abdomen on the corresponding side for a period of seven years. The sac was removed at operation, also with apparent complete relief of symptoms. Stevens cites one other case first seen by Crowell and later operated upon by Hunner and reported to him in a personal communication from Hunner. He also found reports of three other cases noted at autopsy, one by Herbert, one by Pepere and one by Guiteras. This made a total of four clinical cases and three autopsy cases available for study at that time. I assume that the condition is not as rare as these figures would seem to indicate, as there have no doubt been other cases observed which have not found their way into the literature.

Stevens' case was a male, aged fifty-nine, admitted to the hospital with an acute history of pain in the left lower abdomen

accompanied by chills and fever. At operation there was found an extensive perinephritis and a kidney riddled with small cortical abscesses. The kidney and upper segment of the ureter were removed. Upon careful examination two very small diverticula were found in the ureter near the kidney pelvis, one of which had perforated, with the resulting perirenal infection. The patient made a good recovery.

I have found one other case operated upon by Lichtenberg and reported by Marsella. This patient has certain points of similarity to the case which I am about to report. The patient was a male of thirty years of age complaining of dysuria and frequency of urination. Urine was cloudy and contained abundant pus. Preoperative diagnosis was made. There was a diverticulum at the lower end of the left ureter. The right kidney and ureter were normal. At operation the sac and the lower end of the ureter were excised and the ureter was reimplanted in the bladder at its normal site. The operator was able in this case to make the implantation at this point without undue tension of the ureter. Patient made a good recovery. His symptoms were relieved. Cystoscopy performed six months later showed the left kidney and ureter functioning normally.

There have been several other cases reported, notably by Pribram, which it would seem to the writer might better be classed as cases of ureterocele rather than diverticulum. Pribram reports a case of his own and cites three other cases, all occurring in females, in which the ureter lapsed through the urethra. One was a female child of two weeks, in which the mass was removed per urethram, followed by death. One, a girl of six weeks, in whom the sac became gangrenous, and death resulted with no surgical interference. One, a woman of 52, operated upon per urethram, good recovery. Pribram's own case was a woman of forty-five who was operated upon through supra-pubic incision with a good recovery.

Schroeder reports a somewhat similar case, a woman of thirty-one, who had a prolapse of the ureter through the urethra following childbirth. The mass became gangrenous and was removed

per urethram by simple transfixion and ligation followed by a good recovery.

As noted above it would seem that these latter cases might better be classed as ureteroceles. They were reported, however, as diverticula. Omitting these and including the case reported by Marsella, together with the cases reported in Stevens' paper, there are then a total of five clinical cases reported in the literature.

It seems to have been the opinion of all the authors who have written upon this subject that the condition is congenital and part of some defect in the embryological development. It is admitted that the condition might be the result of an inflammatory stricture distal to the site of the diverticulum. I believe that my own case was a congenital defect.

Another case is cited by Dr. Edward L. Keyes in a personal communication to the writer. This case has not previously been reported and through the courtesy of Dr. Keyes, a brief summary is herewith presented.

The patient was a male of thirty-seven, first seen November 24, 1924, who for several weeks had had repeated attacks of severe colicky pain referred to the left loin. For several months preceding this he had suffered a great deal from indigestion. Cystoscopy showed nothing abnormal excepting a diverticulum immediately behind and to the outer side of the left ureter orifice. A No. 6 catheter passed readily to the right kidney pelvis, another seemed to reach the left but radiographs demonstrated that the catheter on the left side was coiled up in the lower end of the ureter (fig. 1). The urine from the right kidney showed 12 grams of urea per liter, no pus and sterile. Urine from the left kidney showed 3 grams of urea per liter and much pus. Culture showed B. lactis aerogenes and a non-hemolytic, non-pigment producing streptococcus. Operation January 23, 1925.

Following are Dr. Keyes' notes made at the time of operation:

Operator: Dr. E. L. Keyes assisted by Dr. Badia.

Anesthesia: Gas-ether by Dr. Flagg.

Duration: One hour.

Procedure: "Median abdominal supra-pubic section. Bladder disclosed and opened. Intra-vesical retractors to the edges of the diverticulum at site of left ureter orifice—grasped with Kocher clamps and

lifted forward. Bladder wall incised in horse shoe shape from around orifice leaving a cornu of the trigone intact. Diverticulum then lifted out of its bed by blunt dissection and split from above downward until its floor could be viewed. No trace of orifice of ureter seen though its

FIG. 1. DR. KEYES' CASE SHOWING CATHETER COILED IN DIVERTICULUM

pelvic course was easily followed leading from the floor of the diverticulum downward into the pelvis. Ureter nicked and split open. Diverticulum excised, the sides of the ureter were sutured with plain catgut to the cut edges of the bladder mucosa; adjacent and above this the

bladder wall was closed by two through and through plain catgut sutures after drainage had been run down to the diverticulum by blunt dissection outside of the bladder. Bladder wall sutured with plain catgut about drainage tube, plain catgut to muscle, cigaret drain."

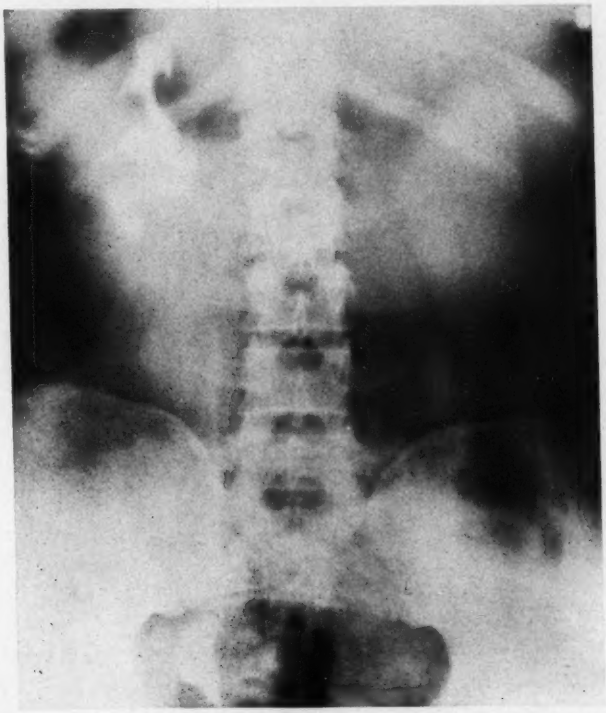

FIG. 2. DR. KEYES' CASE (REVERSED) SHOWING REGURGITATION INTO URETER AND KIDNEY PELVIS FOLLOWING CYSTOGRAM

Findings: "The cystogram x-ray catheter had shown that the orifice of the ureter was inside the diverticulum and had apparently shown some dilatation of the ureter. This ureteral dilatation was not discovered at operation, possibly because of considerable pull that was put upon the ureter after the diverticulum had been freed from its bed."

The patient made a good operative recovery but continued to suffer from frequent attacks of left renal colic. Examination made in December, 1925, and again in May, 1926, demonstrated only a few scattered pus cells in the urine from the left kidney and the urea and phenolsulphonephthalein output only slightly less than its fellow of the opposite

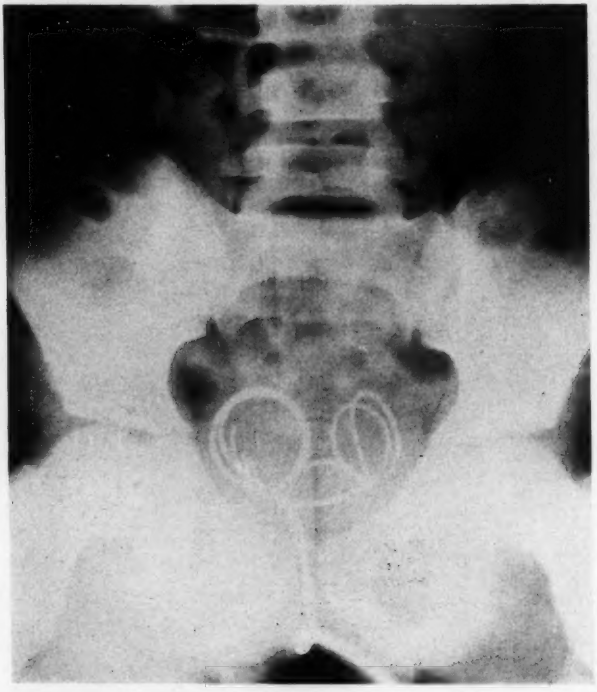

FIG. 3. SHOWING CATHETERS WHICH HAD APPARENTLY PASSED TO KIDNEY PELVIS ON EACH SIDE COILED UP IN DIVERTICULA

side. A cystogram shows a regurgitation of the medium up the left ureter (fig. 2).

While in this case the operation has resulted in a striking diminution of the degree of infection, and improvement in the functional capacity of the kidney, the subjective symptoms have

continued and it is the opinion of Dr. Keyes that he may require further surgery to effect a cure.

Following is a report of the writer's case:

The patient was a boy of ten, admitted to the Urological Service of The Brooklyn Hospital in January, 1926, complaining of dysuria and frequency. He was obliged to urinate six or seven times at night and

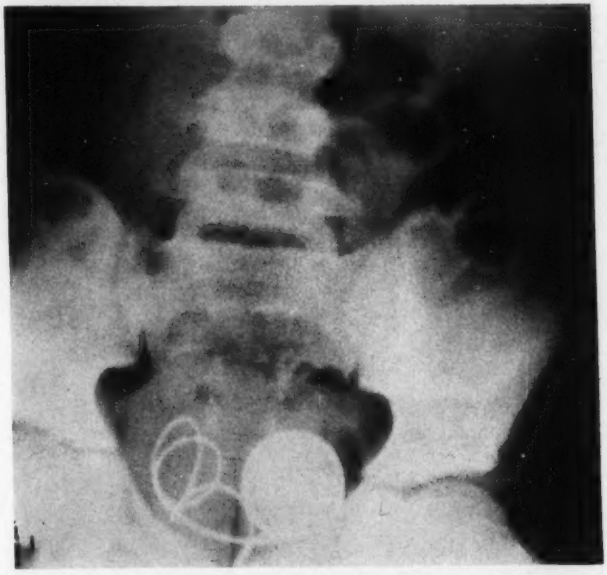

FIG. 4. DIVERTICULUM ON LEFT FILLED WITH SODIUM IODIDE IN AN ATTEMPT TO MAKE A PYELOGRAM

occasionally wet the bed between times. The mother stated that these symptoms had existed since he was two years old and that he was gradually getting worse. On two or three occasions during the past year he had passed a little blood in the urine.

General history. He was a full-term baby, weighing 10 pounds, breast-fed, and seemed normal in every way until his urinary difficulty manifested itself at the age of two. When he was three years old he fell three stories but "was not injured." He was circumcised at the

age of five. For the past three years he has had occasional mild convulsive seizures which have been diagnosed as epilepsy. (This diagnosis was confirmed by neurological consultant during his stay in the hospital.)

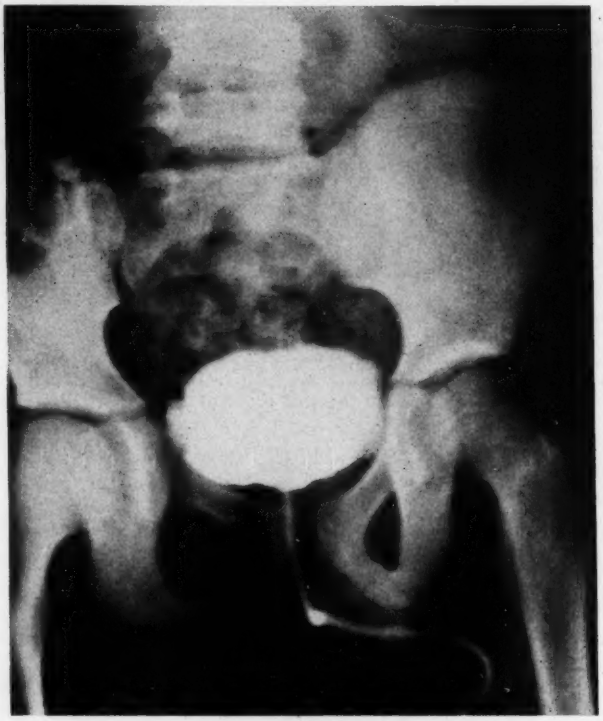

FIG. 5. CYSTOGRAM SHOWING DIVERTICULUM RATHER INDEFINITELY ON THE RIGHT, EVEN MORE INDEFINITELY ON THE LEFT

Examination. Examination disclosed rather a sallow-looking undernourished child much below par in his physical makeup and a little below the average intelligence for a boy of his age. The heart and lungs were apparently normal. Neither kidney was palpable nor was there any tenderness in either loin. The urine was very cloudy, foul

smelling and loaded with pus. A search for tubercle bacilli was negative. Cystoscopy under gas oxygen anesthesia showed a general diffuse cystitis. The ureter orifices were slightly large and gaped a little but were otherwise normal and normally situated. A pair of No. 5 catheters were readily engaged and apparently passed easily to the kidney

FIG. 6. CYSTOGRAM, SODIUM IODIDE REMOVED AND BLADDER INJECTED WITH AIR

pelvis on each side. The urine from each side was very cloudy, loaded with pus and on culture showed B. coli. Following an intramuscular injection of phenolsulphonephthalein there was no trace of the dye in twenty minutes. Radiographs, including an attempted pyelogram, showed the catheters on each side coiled up in a diverticulum (figs. 3 and 4). (This examination was repeated on several occasions, hoping

at some time one or both catheters would find their way to the kidney pelvis but always with the same result. On another occasion cystograms were made which are shown as figures 5 and 6.) At this time operation was advised but not urged and not accepted. He reported at intervals to the out-door clinic and was given various urinary anti-

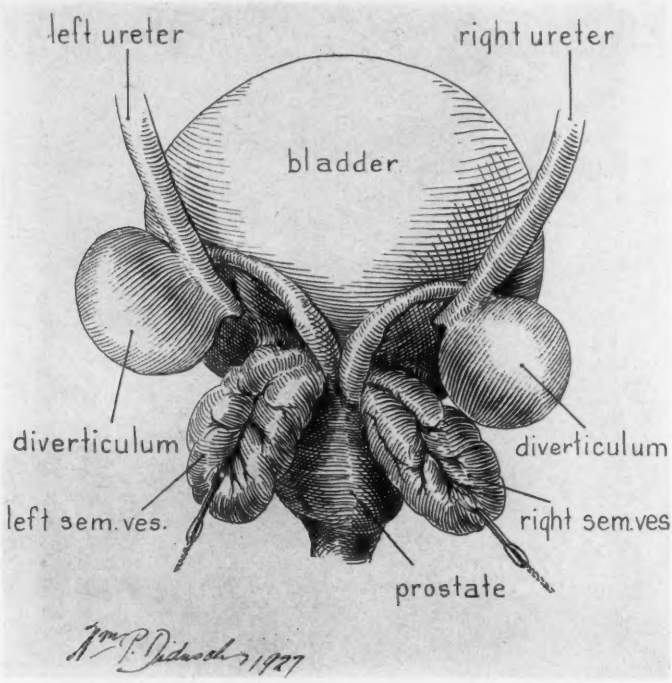

FIG. 7. DIAGRAMMATIC SKETCH OF CONDITIONS FOUND AT OPERATION

septics with no resultant improvement. He was readmitted to the hospital in February, 1927, with the understanding that operation would be accepted if decided upon. His general health had failed considerably in the past year and his bladder symptoms were about the same. The examinations made on the occasion of his first admission were repeated with the same result. Further laboratory data obtained with

a view to determining operability were as follows: Total urine, 400 cc.; total urea, 14.12 grams; phenolsulphonephthalein—first hour, 12 per cent; second hour, 20 per cent; third hour, 10 per cent. Blood chemistry: Urea, 46.5; creatinin, 2.19; sugar, 114. In spite of the obvious evidence of renal damage, operation was decided upon. Pre-operative

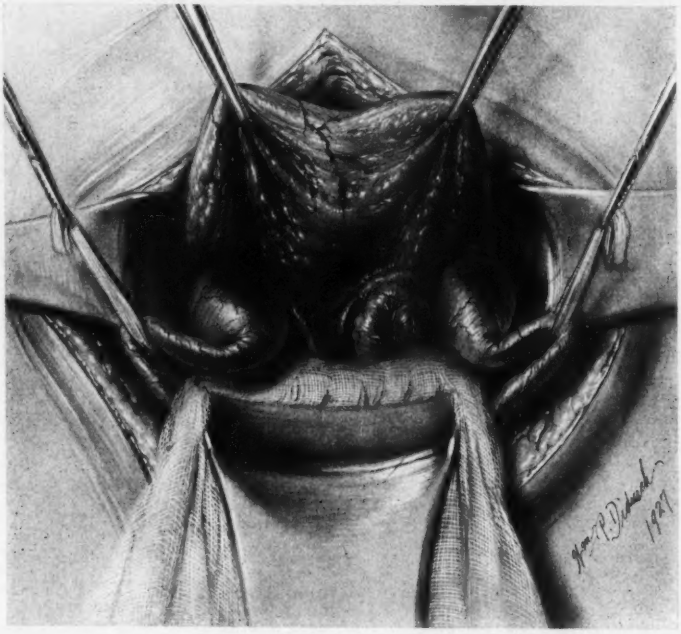

FIG. 8. SKETCH MADE OF OPERATION AFTER PARTIAL SEPARATION OF SACS FROM DENSE ADHESIONS

Right seminal vesicle clearly in view. The left vesical so buried in dense adhesions that it is not visualized.

diagnosis: Diverticula of the bladder with ureters emptying directly into them.

Operation. March 4, 1927. A somewhat enlarged and much thickened bladder was fully exposed and freely mobilized through an extra peritoneal median incision extending from symphysis to umbilicus.

The diverticula were found in the depths of the wound buried in a mass of adhesions, particularly on the right side where it was with difficulty dissected free from the seminal vesicle. The sac apparently consisted of the lower end of the ureter communicating with the bladder through

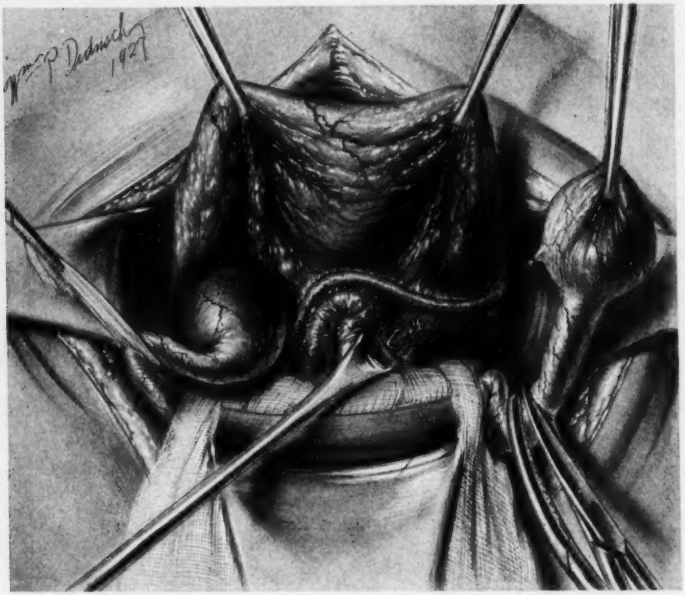

FIG. 9. LATER STEP IN OPERATION

Sac on the right has been entirely freed from the bladder, ureter is being amputated about 1½ inches proximal to the sac. The same procedure was then carried out on the other side. The tubular character of the bladder end of the sac is somewhat exaggerated in the drawing. There was a very small opening in the bladder and the separation was made by an incision flush with the bladder wall and the wound in the bladder wall was closed with a single suture.

a tiny opening at the normal site of proximal end of the intramural portion and above with moderately dilated and much thickened ureters. The sacs and about 1½ inches of ureter immediately above were excised and the bladder openings closed with a single chromic suture. The bladder, which up to this time had not been opened, was now opened

through a slit made near the summit. The ureters were reimplanted in the posterior wall fairly high up. A Pezzer catheter was anchored in the bladder, rather free pre- and peri-vesical drainage and the usual closure around the drains. The findings and the various steps of the operation are fairly well illustrated wtih accompanying sketches which, although somewhat diagrammatic, show with reasonable accuracy the

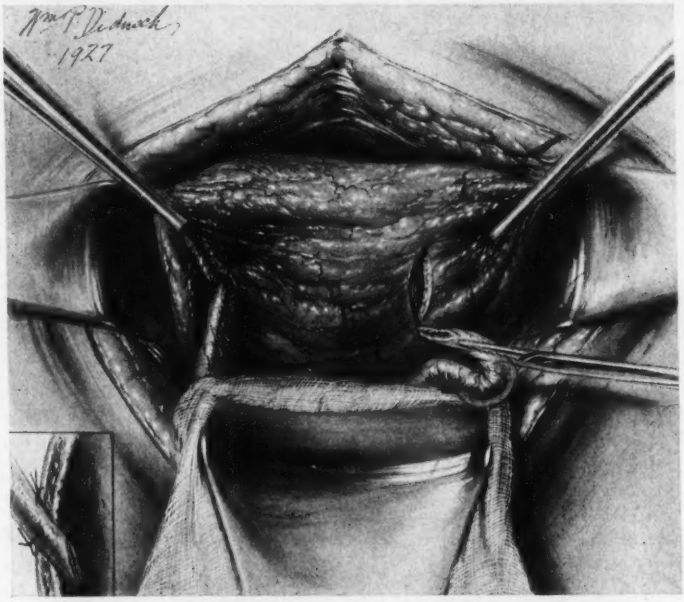

FIG. 10.

Left ureter has been reimplanted in posterior wall of bladder. Right ureter about to be implanted. Insert shows the very simple technique employed in making anastomosis.

findings and the procedure. The specimens removed were discussed by the pathologist as consisting of two cystic cavities, practically identical in appearance. Measurements made after the usual shrinkage which takes place in such specimens showed them to be 2 cm. in diameter and 4 cm. in length and connected with a segment of ureter 5 cm. long and 2.5 cm. in circumference. They were lined with transi-

tional epithelium continuous with and of the same type as the epithelium lining of the ureter itself, which showed numerous small hemorrhagic areas and several small superficial ulcerations. There were definite evidences of inflammatory reaction throughout. There was

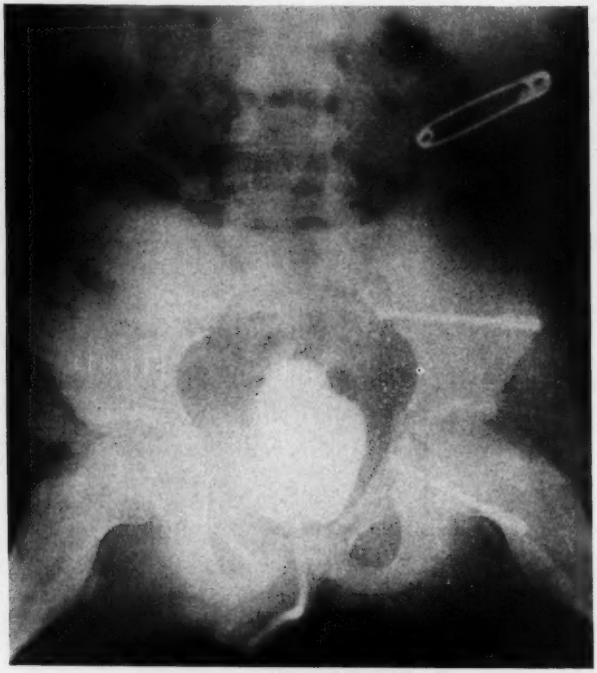

FIG. 11. CYSTOGRAM OF BLADDER MADE SIX WEEKS AFTER OPERATION

For some unknown reason there is no evidence of regurgitation of the medium up the ureters.

marked hypertrophy of the musculature, both of the sac wall and the ureter.

The patient made an uneventful post-operative recovery and the wound healed per primam except at the point of drainage exits. The bladder tube was left in situ for four weeks and bladder irrigations were given daily through the tube during the last two of these four weeks.

The supra-pubic fistula healed fairly promptly after the tube was removed. The boy's general condition is strikingly improved; he looks and feels much better. He urinates only once at night and is able to go for three or four hours by day. There is no dysuria and while the urine still contains abundant pus, it looks much better than before operation. The blood urea taken six weeks post-operative is 34.5 as against 46.5 pre-operative. The phenolsulphonephthalein remains about the same. A cystogram was made on April 19, 1927, which is shown in figure 11. Oddly enough there is no evidence of regurgitation to the kidney pelvis which I rather confidently expected to find. While the immediate improvement following the better kidney drainage has been very striking, I am not very optimistic about the long pull. Since both kidneys are undoubtedly badly damaged it is hardly reasonable to hope for a sustained improvement.

COMMENT

There are at least three points which suggest themselves for discussion.

1. Were these sacs diverticula of the ureters or of the bladder? I believe they were congenital and embryologically they might be either. In view of the normal location of the ureter orifice and the findings at operation, I think it is fair to classify them as diverticula of the ureters.

2. Were we warranted in undertaking this rather formidable procedure with such scant prospect of permanent improvement? The fact that the patient made a good operative recovery and is having some temporary relief from symptoms would seem to answer this question in the affirmative.

3. Should we, instead of employing the very simple method which we did for transplanting the ureter, have attempted some sort of plastic operation for the purpose of maintaining a valvular action at the uretero-vesical juncture. We were operating on a bad risk, the operation at best was rather prolonged and difficult and at the same time it seemed that the shortest way was the safest if not the best method.

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THE PART THAT OBSTRUCTION OF THE URETER PLAYS IN THE OUTCOME OF CANCER OF THE BLADDER

ARTHUR L. CHUTE

Boston, Massachusetts

My very brief communication is based upon some operative and autopsy findings regarding the condition of the ureters in cases of cancer of the bladder. These findings I believe have some bearing on the treatment of this condition. Within the past two years I have had the opportunity to have the autopsy findings in 14 cases of malignant disease of the bladder, upon which I had operated. In a few of the cases an extensive operation had been done; in others a partial resection; in a few there had been nothing further than suprapubic drainage under local anesthesia. The main point of interest is this, that in these 14 autopsies we found *12* cases in which a ureter was more or less dilated due to compression by disease; in *4* of these instances both ureters were dilated. In a considerable proportion of these cases there was evidence of renal infection as well. In 2 of these patients there were glandular metastases and 2 others there was an extension of the disease into the pelvis, quite in keeping with Judd's (1) recent article in which he reports 21 metastases in 166 cases of cancer of the bladder.

I was interested to look up the condition of the ureters in these cases because in spite of the fact that it was pretty generally conceded that cases of cancer of the bladder had a relative freedom from metastases, yet a large number went on and faded away without in many instances symptoms that were sufficiently definite to allow one to say just what process brought about the fatal outcome. It seemed to me that interference with the renal function might account for this condition of affairs.

It has been very generally accepted that interference with the

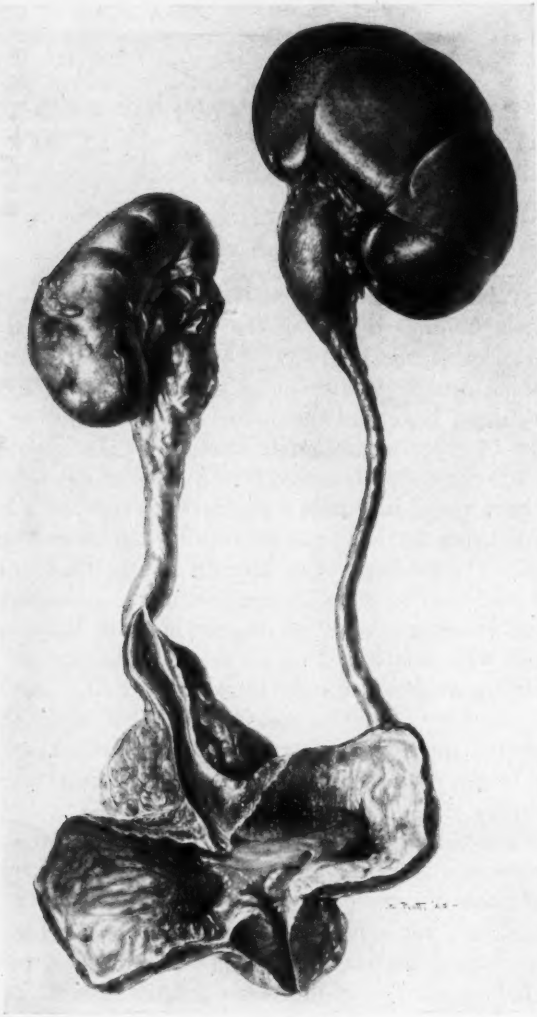

FIG. 1. INFECTED HYDRONEPHROSIS AND HYDROURETER ON RIGHT—BEGINNING HYDRONEPHROSIS ON LEFT. IN A PATIENT WHERE EXTENSION OF A CARCINOMA OF THE PROSTATE TO THE BLADDER HAD PINCHED THE LOWER ENDS OF THE URETERS

renal function, often accompanied by infection, was one element that entered into the fatal outcome in these cases of carcinoma of the bladder: Kidd (2) has referred to this and quoted others who held the same views. I had supposed, however, that this was an occasional occurrence rather than a common one. Such of the literature of ureteral transplantation, as relates to its application in cases of malignant diseases of the bladder, mentions frequently the occurrence of dilatation of the ureter, particularly in connection with the difficulty of implanting such a ureter. These findings suggest to me that dilatation of the ureters may be a pretty general occurrence in cases of carcinoma of the bladder and account for a considerable element of the mortality in these cases, particularly in some of the instances in which a patient with carcinoma of the bladder just fades away without any symptoms that are sufficiently distinctive to allow one to say just what was to be considered the immediate cause of death.

The condition is an easy one to overlook during life unless one is on the lookout for it. Operations for tumors of the bladder are carried out in such a way that the operator might well see nothing of a process of this sort, even though it were quite marked, except in instances of fairly wide bladder resections with reimplantation of a ureter. This dilatation of a ureter is not invariably present in tumors of the bladder but it is present in a very considerable proportion of cases and is, I believe, a distinct element in producing the fatal result which is often attributed to the extension of the malignant disease itself. It must, I believe, be considered in our operative treatment of these cases.

As bearing upon this, I wish to describe an interesting point that I observed in the case of a man who died a month after I had done a radical operation for carcinoma of the bladder. We found at autopsy that one of his ureters, which had been dilated nearly to the size of my thumb, at the time of operation when we implanted it, was at the time of autopsy, practically of normal size. This change took place in the period of a month and shows a very encouraging tendency for these ureters to be restored to a more or less normal condition, if the proper opportunity is given them. We likewise found that the joint between the ureter and

the sigmoid seemed to be perfect, though there had been leakage following operation.

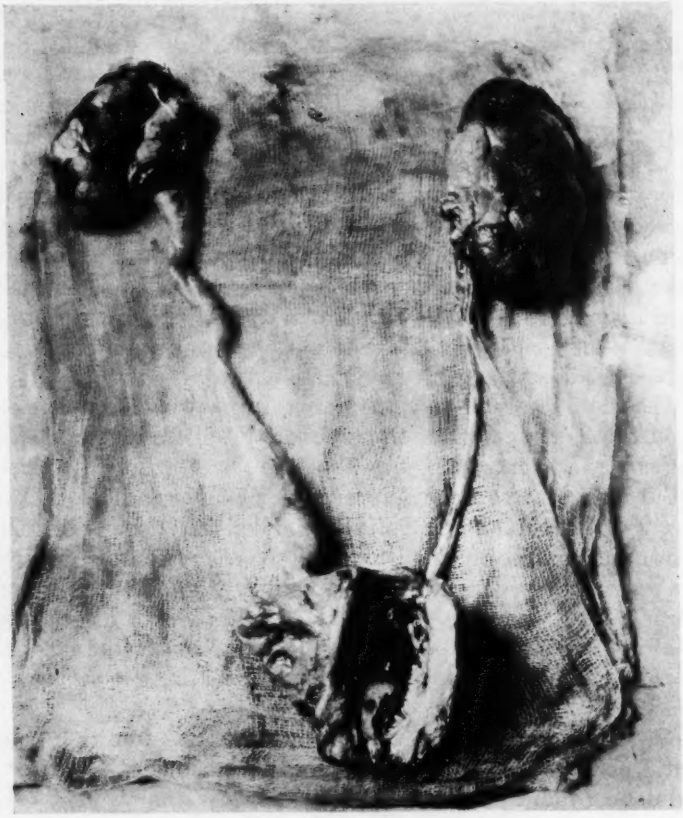

FIG. 2. AN INSTANCE IN WHICH A CARCINOMA OF THE BLADDER OBSTRUCTED THE RIGHT URETER, LEADING TO A FUNCTIONAL DESTRUCTION OF THE RIGHT KIDNEY

If this involvement of the ureter and presumably secondary renal involvement is as common as I have found it in cases of cancer of the bladder and if it plays so important a part in the

fatal outcome of these cases, as I am inclined to believe it does, it is self-evident how futile it is to use radium or fulguration in these cases with any other purpose than simply to palliate the condition. These methods of treatment do not take into consideration at all the element of renal back pressure, or infection, nor do they do anything to relieve it: in fact it would seem that the scar tissue, which almost invariably follows the use of radium or fulguration, would increase rather than diminish it. By fulguration I mean the deep, heavy fulguration, and not the light fulguration applied through a cystoscope which seems to me the most satisfactory method of treatment that we can apply to superficial growths of the bladder of the epithelial type.

In closing I wish to say that I believe evidence is accumulating to indicate that obstruction of the ureter plays an important part in the fatal outcome of cases of malignant disease of the bladder; that to combat this condition successfully we must not only remove the malignant disease but we must also remedy the obstruction of the ureter.

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OBSERVATIONS ON THE TECHNIC OF URETERO-ENTEROSTOMY

GEORGE GILBERT SMITH

With rare exceptions implantation of the ureters into the bowel is indicated in only two conditions—exstrophy of the bladder and cancer of the bladder. In the first of these, the youthful vitality of the patient must be a considerable factor in the success of the operation. Patients with cancer of the bladder are usually past the prime of life; frequently their resistance has been lowered by hemorrhage, cystitis, pyelonephritis, and the absorption of the toxin of cancer, whatever that is. These factors diminish the healing powers of the individual and his resistance to infection. In addition to the detrimental effects of cancer upon the system in general, the growth in the bladder may have obstructed a ureter, causing dilatation and infection of the upper urinary tract.

The observations which I shall record here were all upon cases of cancer of the bladder. In this disease, suitable cases for transplantation of the ureter to the bowel are not encountered very frequently. Earlier diagnosis of tumors and improvements in the methods of employing radium and electrocoagulation have made most cases operable in a less radical way, with better chances of obtaining relief. If the cancer has progressed to a point where these measures will not avail, there is usually little use in attempting cystectomy. There are, however, some few cases of persistently recurring, widely disseminated superficial growths in which cystectomy offers a possible road to cure.

This paper is not concerned with the indications for this operation, so much as with the technic of its performance. The results in ten cases are recorded. Four of these survived so far as the uretero-enterostomy was concerned; six died as a result of

the operation, or if they survived the operation for a time, the results of it were unsatisfactory.

These cases were as follows:

Case 1. July, 1925. A man of fifty. Total cystectomy and implantation of the ureters into the rectum at one operation. The patient died within twenty-four hours of shock and hemorrhage.

Case 2. December, 1921. A man of forty-eight, with an extensive carcinoma of the bladder which could be palpated suprapubically. December 17, 1921, the left ureter, which was dilated to a diameter of 0.5 cm., was exposed through a gridiron incision just above and to the inner side of the anterior superior spine. The peritoneum was pushed inwards and a loop of descending colon drawn out through a small incision. Into this loop the ureter was implanted by Coffey's method. This was before Coffey had suggested the use of an inlying tube. The anastomosis was made extraperitoneal by tacking the edges of the peritoneal incision to the wall of the bowel. This anastomosis worked well.

The rectal tube drained urine two days after the operation and there was no urinary leak. January 4, 1922, a similar operation was done on the right ureter which was dilated to a diameter of 1 cm. and contained pale, cloudy urine. A loop of cecum was drawn out through a small incision in the peritoneum and the anastomosis made extraperitoneal. There was no leak for six days; then the right ureter began to leak, and on January 23, five weeks after the first operation, the left ureter began to leak. The patient was discharged February 15 with bilateral fistulae. I believe that his general condition was so poor that the wounds broke down from the effect of a low grade infection.

Case 3. July 11, 1923. A colored man of forty-nine who had had cystotomy and radium implantation. His wound never healed, and he was miserable because of the leakage and the severe cystitis. July 11, 1923, the right ureter, which was dilated to 1 cm. in diameter, was implanted in the cecum extraperitoneally. Two weeks later the wound was healed and he was up and about. July 31, the left ureter was implanted in the descending colon. The patient did well for four days, and had large watery dejections. On August 4 he suddenly went into collapse, became greatly distended and died. Autopsy showed that the suture line of the left anastomosis had sloughed, allowing leakage of feces. There was no peritonitis and no kink in the ureter. The left

kidney was large, flabby, full of pus. The cortex was a pale gray streaked with red. The right kidney was only a third as large as the left. The cortex was thinned, the pelvis full of pus. Fluid injected into the right ureter squirted into the lumen of the bowel. The anastomosis was well healed; the ureter ran through the wall of the gut for 2 cm. and projected into the lumen of the gut 0.75 cm. The orifice was not contracted; the wall of the ureter where it was free in the bowel was 1 mm. in thickness. (Specimens exhibited.)

Case 4. September 20, 1925. A man of fifty who had had an adenocarcinoma removed from the bladder and a prostatectomy six months before. At the present examination the left side of the bladder was found to be the seat of a sloughing tumor. September 23, median laparotomy. The right ureter appeared normal, the left was dilated to a diameter of 1 cm. and filled with cloudy urine. Both ureters were divided and rubber tubes passed up them until the flow indicated that the tubes had entered the pelves. The ureters were then implanted in the upper third of the rectum, within the peritoneal cavity, the tubes being drawn out through the anus. The ureters were implanted separately, the left higher than the right. A rubber drain was left in the pelvis. Both tubes drained well from the start. There was persistent abdominal distention, in spite of the employment of hypodermoclysis, pituitrin and stupes. The stitches were removed September 30, one week after operation. That night the wound broke open and a loop of small intestine protruded. The patient was etherized, the gut cleansed and replaced, the wound resutured. The tubes came away October 1. October 5, a urinary leak was noticed, although some urine was passing by rectum. By October 30 most of the urine and some feces were passing through the wound. The patient was obviously failing; the right kidney was large and tender. The non-protein nitrogen was 31 mgm. per 100 cc. October 31, under scopolamine and morphia, paravertebral anesthesia and a little ether, the right kidney was exposed. It was large and pale. Mercurochrome injected into the ureter came out through the abdominal sinus. The ureter was tied and divided close to the kidney pelvis, and the kidney drained by a tube through the cortex. The patient did fairly well for a week; he then developed pneumonia and died. I believe that faulty closure of his abdominal incision was the cause of his extreme distention, and that the distention prevented the anastomosis from healing firmly.

Case 5. November 15, 1926. A woman with phthisis and carcinoma of the bladder, suffering severely from frequent, painful urination. Both ureters were implanted through the same incision in the anterior longitudinal band of the intraperitoneal portion of the rectum, with inlying tubes extending from the renal pelves out through the anus. The right ureter was strung across the pelvis from the pelvic wall to the rectum, and although I feared this might allow a loop of intestine to become strangulated, I could see no way of avoiding this. Neither ureter was under any tension, and neither was dilated. Both tubes drained well at first, the right less than the left. Six days after operation the temperature rose to 100° and the right kidney became enlarged and tender. Nine days after the operation urine began to leak through the sinus. The next day both tubes came away. The patient became distended and began to vomit. Although the bowels moved, it was evident that she had a partial intestinal obstruction. She was relieved by gastric drainage by means of a Levin's tube passed through the nasopharynx into the stomach, but her obstruction became more evident and on November 30 an enterostomy was done. No attempt was made to find the obstruction. There was no peritonitis. She died two days later. Until her death urine drained from the sinus, but there was no fecal leakage. She also passed urine by rectum up to the last. I believe that a loop of gut became caught beneath the right ureter and by its distention pulled the ureter out of the bowel.

Case 6. January 3, 1922. A man of forty-seven who had had a cystotomy with implantation of radium four months before. Cystoscopy showed a generalized recurrence throughout the bladder. January 4, 1922, the right ureter, apparently normal, was implanted extraperitoneally into the ascending colon. Four days later the patient passed urine by rectum. January 17, the left ureter was implanted into the sigmoid intraperitoneally. January 25, the patient was voiding 150 ounces per day. The urine contained no pus. February 7, the bladder was removed by a combined perineal and suprapubic operation. The rectum was opened and resutured, but leaked and delayed convalescence. In two months, however, the fistula was practically closed and the patient was discharged. June 14, 1922, the patient reported that he could hold his urine four to five hours. He had gained weight, felt well and had played cricket. In July he began to complain of pain in the spine. X-ray showed destruction of the 5th lumbar vertebra, and a shadow in the region of the left kidney which was thought to be a stone. From

that time on the patient failed, dying October 8, 1922. His wife wrote me that she did not feel that his relief from the operation was worth the effort he had made.

Case 7. May, 1922. A man of sixty-one with inoperable cancer of the bladder. May 10, 1922, the right ureter was implanted into the ascending colon extraperitoneally. May 31, the left ureter, thin-walled and dilated, was implanted into the descending colon, also extraperitoneally. There was a slight leakage from the right side for five weeks; the left healed in three weeks with no leakage. The patient was discharged June 25, and died the following February.

Case 8. February, 1925. A doctor of sixty-seven, whose right kidney and ureter I had removed because of a carcinoma of the vesical end of the ureter. The growth had recurred twice in the bladder. September 26, 1925, the left ureter was implanted in the rectum by Coffey's technic, with a tube carried from the renal pelvis out through the anus. This tube came away ten days after operation. Convalescence was uneventful. October 14, total cystectomy was done. Again convalescence was satisfactory. The patient enjoyed life, played golf, was able to get through the night with only one urination, and survived broncho-pneumonia that winter. He continued in good health until September, 1926, eleven months after operation. A recurrence of his cancer in the bladder region then began to trouble him, and he died November 6, 1926, of progressive cachexia. His kidney functioned well until the end, and he himself felt that the operation had given him great relief.

Case 9. A man of fifty with cancer of the bladder. July 26, 1926, I opened his bladder with the idea of destroying the growth by diathermy. The carcinoma was so diffuse that I was sure I could not help him except by a total cystectomy. This was done at once. Except for a few tears, the peritoneum was not opened. The left ureter was dilated and full of cloudy urine; the right appeared normal. Both were cut close to the bladder; tubes were passed to the kidneys, and the ureters were implanted into the rectum, extraperitoneally, through the same incision. The operation lasted three hours and for twenty-four hours thereafter the patient was in a critical condition. His condition then improved. Four days after operation, an intravenous phthalein test gave 20 per cent in fifteen minutes from the right kidney, no func-

tion from the left. August 2, seven days after operation, the left tube was accidentally pulled out, and the patient began to leak urine through the abdominal incision. August 5, he began to leak feces. August 11, the right tube came away. The fistula gradually closed and on September 10, six weeks after operation, the patient was discharged from the hospital. December 13, his non-protein nitrogen was 32 mgm. per 100 cc. He was holding urine for three hours; the wound had healed and his condition was good. I saw the patient May 25, 1927, ten months after operation. He looked well and asked if he might go to work. He held urine all night without voiding, and only occasionally leaked a little from the rectum. Neither kidney was palpable or tender. The non-protein nitrogen was 39 mgm. per 100 cc. of blood. The urine looked clear, but showed a slightest possible trace of albumin and 35 to 40 leucocytes per field in a centrifuged specimen. His wound was entirely healed.

Case 10. May 2, 1927. A man of sixty-eight years. The bladder was opened with the intention of destroying the growth by electrocoagulation. The mucous membrane was found to be studded with low, solid appearing tumors which did not appear to penetrate the wall very deeply. Total cystectomy seemed the only measure which would offer relief. This was done immediately and the ureters were implanted in the rectum extraperitoneally. There was not much bleeding. The operation was done under spinal anesthesia plus $2\frac{1}{4}$ of morphia and $\frac{1}{150}$ of scopolamine. Following the operation the patient exhibited shock and, in spite of stimulation and intravenous saline, he died six hours later.

From the preceding cases I have drawn a few definite conclusions.

1. It is inadvisable to attempt uretero-enterostomy as a relief measure in cases with inoperable cancer of the bladder. The poor condition of the patient is likely to interfere with healing, the infection which is almost sure to exist in the kidneys will flare up under the new conditions of drainage, and the period of relief is too short to make the effort worth while.

2 Successful anastomoses have been made by implantation of ureters into the ascending and descending colon respectively, without the use of tubes. Wherever possible, the procedure sug-

gested by Coffey, so far as the use of an indwelling tube is concerned, is of distinct value, as it provides for immediate and continuous drainage of the kidneys. The implantation of both ureters through the same incision in the anterior wall of the rectum intraperitoneally is unwise, inasmuch as this method causes the right ureter to be strung across the pelvis like a clothes-line, and invites intestinal strangulation.

3. The removal of the bladder and the implantation of both ureters in the rectum extraperitoneally, which has to be done at one sitting if done at all, has given an excellent result in one case, but it is too extensive an operation for most patients to stand.

I believe that the most rational procedure is that suggested by Hinman, namely, a preliminary nephrostomy. Cystectomy can then be done, and if the patient survives that and shows no evidences of recurrence, uretero-enterostomy can be done at a time when the patient is best able to stand it and is in the best condition to secure prompt healing. This means an extra operation, but it does away with many of the dangers which, by any other method, attend the implantation of the ureters into the bowel.

DISCUSSION

Dr. Edward L. Keyes (New York City): Inasmuch as Dr. Rathbun quotes one of my cases, I show the two slides, one of them representing a catheter curled up and the other one representing an injection of fluid into the ureter. If you will compare the two, you will find that the catheter is not curled up, as I understood Dr. Rathbun to misunderstand, in the place where the dilatation of the ureter is shown. The catheter is curled up in the diverticulum which was perfectly visible in the bladder and from there it happened to enter the ureteral mouth which was in the diverticulum and then to go into the ureter above. The diverticulum of the bladder was removed with knowledge that the ureter opened into it. I split up the bladder until I thought I had reached the ureteral diverticulum. I did not go far enough. The ureteral diverticulum is still in the patient. The kidney has become pyonephrotic, but he does not want to be operated on any more.

Dr. William C. Quinby (Boston): These four papers have interested me very much. I will not, however, take your time to speak to the first two, but in regard to the paper of Dr. Chute and that of Dr. Smith, I want to express my deep appreciation of their efforts in regard to this aspect of bladder carcinoma. Both Dr. Chute and Dr. Smith have done, and are doing, very pioneer work in this matter. I think there is no doubt whatever in the minds of all of us that it is necessary, if possible, that some further therapeutic measure be attempted rather than mere local excision of bladder carcinoma or treatment of such a growth by the various high frequency methods of radiation by radium or fulguration. The results following resection of the bladder and transplantation into the bladder again of the ureter, have not been sufficiently good to warrant our resting satisfied

with this method of treating bladder malignancy, and I think that the future will undoubtedly show that in cases of extensive bladder malignancy a total cystectomy is the best answer to the problem which such patients bring. A total cystectomy is a difficult operation; it is an operation that most of us are not sufficiently familiar with, not having operated many times. Therefore, the work which Dr. Chute and Dr. Smith have done and their reports thus far made, are the more commendable.

I have tried to follow their lead and have removed the bladder in four cases of malignancy. There have been two operative deaths, without doubt due to failure of operative technic. There have been two successes. I reported the next to the last one at a meeting of the New England Branch of the American Urological Association in Boston last winter, and there has been one case since. I have not attempted to remove the bladder and transplant the ureters extraperitoneally. It somehow or other does not appeal to me. It may be a good way, but it is not the way that I personally approach the problem. I have done all these operations transperitoneally, and in the first three made the operation in two stages, transplanting the ureters into the sigmoid. I have had just the difficulty which Dr. Smith refers to, in two instances, namely, partial intestinal obstruction after a successful anastomosis of the ureter. In the last instance, I adopted a measure which I had used in two cases of removal of the bladder in children for extrophy, of transplanting the ureter on the left into the sigmoid, on the right into the cecum. The ureters so transplanted are, so far as I can see today, perfectly functional. In all instances that I remember, at least one of the ureters has been dilated, as has been brought out by Dr. Chute.

I can only repeat, in closing, my firm conviction that we must report all instances of such operations in order that the sum total of our knowledge will give us further detail in just what to do; in just how to handle this very definite problem.

Dr. VERNE C. HUNT (Rochester, Minn.): I likewise have appreciated very much the papers of this last group. Dr.

Chute's paper and Dr. Smith's have dealt with the interesting subject of disposition of the ureter in cancer of the bladder. I think that in pretty nearly all cases of cancer of the bladder, certainly those that involve the base, disposition of the ureter is the most important part for consideration, and I think that when any surgical procedure is adopted that has to do with disposition of the ureter, we immediately increase the mortality rate considerably. That is, we know that in carcinoma of the bladder existing in the dome or high in the lateral walls which does not encroach upon the ureteral orifices, resections, segmental or otherwise, can be done with a very low mortality rate. However, the moment that the ureter is involved in the surgical procedure, the mortality rate immediately becomes very high. However, when one ureter is involved and the carcinoma is resectable, it has been our experience that it can be done with lower mortality rate if ligation of that ureter is done rather than transplantation. Two years ago I found that the mortality rate for segmental resection and ligation of the ureter at the time was accompanied by a mortality of 13 per cent, whereas resection with reimplantation was about 30 per cent, and the interesting thing about it, too, has been that when the ureter is dilated with a hydronephrosis on that side, it usually is a clean kidney and you can ligate that ureter and drop the kidney back without resorting to subsequent nephrectomy.

The question of transplantation of the ureter into the sigmoid is a very interesting one and I think that we are indebted to Dr. Coffey for his contribution which is of a highly scientific order. However, from the standpoint of a practical application, I question very much whether it possesses the value which we were led to believe it possessed, particularly on the basis of the mortality rate. When the article of Dr. Coffey's first came out, we developed a moderate amount of enthusiasm which was hardly justified, because most of the transplantation of the ureter into the sigmoid that had been done previously in the clinic has been done by the C. H. Mayo method with a very low mortality rate. It seemed that bilateral simultaneous transplantation

might be adopted. However, from our experience, we found that it immediately increased the mortality rate.

I speak of this because I want to emphasize the fact that bilateral simultaneous transplantation of ureters is an exceedingly formidable procedure, it is more than the patient can usually stand, and while we have successfully done the operation in a number of cases, it has been accompanied by a very high mortality rate. So we have discontinued the use of the bilateral simultaneous transplantation for all conditions and have reverted to the single transplantation, one operation at a time. I think that if transplantation of the ureter is considered at all, and it has reason for consideration in the surgery of carcinoma of the bladder that is operable, we must take into consideration the involvement of one or the other kidneys. Any operation that has to do with transplantation must be looked upon as an operation upon single kidneys, and we know that the operation upon single kidneys, no matter what the operation may be for, is accompanied by a very high mortality rate.

I believe that the operation of transplantation, so far as cancer of the bladder is concerned, should be confined to those cases that possess some degree of operability.

Dr. HUGH CABOT (Ann Arbor): I am particularly interested in Dr. Chute's findings, because they fit very closely with ours. I am inclined to go rather further than he seemed to be inclined to do in the very high proportion of dilatation of the ureter. We had occasion to go over all of the cases of cancer of the bladder which had come to autopsy and in no case in that series, which was not large (twenty-odd cases) we were able to satisfy ourselves that death had occurred from nothing except urinary insufficiency. There was no evidence there that the patients had died from cancer. I think they practically always die of renal insufficiency.

One of the results of that inquiry was to show that the other ureter, so to speak, is often dilated from obstruction when it is not expected, the cause of which can extend under the mucous membrane considerably further than was appreciated. We

found bilateral dilatation in cases where we had not at all suspected it.

We have had some experience in the field that Dr. Smith has described and our conclusions are very similar to those stated by Dr. Hunt. I have not had satisfactory results with the tube in the ureter, suggested by Coffey, and we have entirely abandoned it. The immediate results were not particularly satisfactory and the end results were not any better, or I think as good as those in which it was not employed. We have not been successful with the simultaneous bilateral transplantation and have gone back to transplanting one at a time.

I entirely agree with Dr. Hunt's conclusion that the operation of transplantation should be confined to those cases in which you honestly believe that cure of the bladder growth is within the realms of possibility.

Dr. Andrew J. Crowell (Charlotte, N. C.): I saw in Edinburgh last summer, a patient on whom a total cystectomy had been performed following the transplantation of the ureters into the inguinal region, which apparently was very satisfactory up to the time I saw the patient. Far advanced carcinoma was the condition for which the cystectomy was performed. Cystotomy did not relieve the symptoms, but was perfectly comfortable and rapidly gaining in weight one month after the cystectomy. The device for draining the urine from each ureter into a rubber urinal was ideal. The patient could take care of the apparatus, keep himself dry and comfortable.

Dr. J. Dellinger Barney (Boston) (closing): I have nothing to add except to express the hope that perhaps next year I can throw some further light on the problem by a further study of the case which I reported.

Dr. George Gilbert Smith (Boston) (closing): I would like to say a word about the use of the ureteral tube. It has seemed to me that that has been a great help. Previous to the use of that, after transplantation of the ureter, it would be four or

five days before there was any urinary flow from the transplanted side. With the passage of rubber tubes up the ureter, the flow has started immediately after the tube was inserted, and has continued, unless there was some difficulty with the placement of the tube in the kidney pelvis, which I think is a possibility.

One must be very careful at the time of operation to get the tube inserted to such a distance that it drains regularly from the kidney pelvis, and then, as Coffey has advised, the tube is fastened to the tip of the ureter by a circular suture. As a rule, the tubes have drained steadily after being brought out through the anus and it has certainly seemed much more satisfactory. You can follow the function of the kidney; you can wash the kidney pelvis with mercurochrome every four or five hours, if you wish to have that done, and when the tube comes away after a week to ten days, the flow of urine is at once taken up in a natural way. It seem to me that the backing up of the urine in the kidney pelvis, which must take place after the implantation of a ureter without a tube, is much more likely to create a severe infection of the kidney pelvis, than is the possible superficial mucosal infection caused by the insertion of the tube, particularly since you have the tube in there as a means of irrigating.

In regard to the external drainage that Dr. Crowell speaks about, I remember that when Dr. Cabot was at Massachusetts General Hospital, we had one or two cases of that sort, and, as I recollect it, our difficulty then was that these ureteral orifices would sometimes contract and had to be kept dilated.

I see no reason why eventually the ureteroenterostomy can not be done successfully, when we get the technic standardized and put on the safest possible basis, and I believe that the result is going to be so much more satisfactory to the patient than having an external urinary fistula, that it will be a method which is much more desirable.

PRIAPISM OF UNUSUAL ETIOLOGY

CASE REPORT

W. A. FRONTZ

From the Brady Urological Clinic, Johns Hopkins Hospital

Neoplasm of the penis both primary and metastatic is usually regarded as a possible etiological factor in the production of priapism. Priapism of this etiology, however, must be extremely rare and in a review of 170 cases in the literature made by Hinman in 1914, in no instance did malignancy play a primary rôle. The following case is considered therefore worthwhile reporting.

The patient was a male fifty-one years of age, a Welshman by birth and a coal miner by occupation for forty-two years. He was admitted to the Johns Hopkins Hospital, March 8, 1927. His complaint was "a constant erection" of four months duration. Past and family histories are irrelevant. None of his immediate relatives has had any tumor growths or tuberculosis. None has had priapism. The patient had an herniotomy twelve years ago which has recurred. He injured his left testicle nine months ago but there have been no symptoms related to the injury. He has lived the normal life of a married man. Denies both luetic and Neisserian infections. His sexual relations have been entirely normal. He has a wife living and well and two children. There have been no miscarriages.

The present illness began eight months ago when he had an attack of painless hematuria which lasted a week. This was not accompanied by pain or straining at the end of urination. There was nothing suggesting vesical or renal calculi. After a week the hematuria ceased. Four months later, which was four months before admission, the hematuria recurred. It again was symptomless. For diagnostic purposes he was cystoscoped. Immediately following the instrumentation his penis became erect and this has persisted for the past four months, though not quite to the degree with which it first appeared. During the past six weeks he has had frequency day and night. The semi-erection causes considerable pain. He has had no intercourse since the onset of the

priapism and there has been no sexual desire whatsoever. Because of the persistent priapism he has become very nervous, his appetite is poor and some nausea recently appeared. He has remained in bed during the last three months because of the difficulty of walking with the priapism and increase of pain in the penis caused by locomotion. Inasmuch as the priapism occurred after cystoscopy, it was thought that it belonged to that class of cases following instrumental trauma.

Physical examination. Temperature 99. Pulse 132. Respiration 28. White blood cells 10,600. Hemoglobin 75 per cent. Blood pressure 120/80.

The important findings in the physical examination on admission were as follows:

The patient was a Welshman of fifty-one years, rather thin and seemingly very nervous. There were numerous dark pigmented scars scattered over his face, neck, arms and chest. His tongue was somewhat coated and all his teeth had been extracted. There was no general glandular enlargement. Chest and its contents were entirely normal, except for a rapid pulse 132 p.m. Abdomen negative except for inguinal hernia scar and recurrence of hernia on left side.

Examination of genitalia: There was a curious penile deformity—the penis projected at an angle of about 45 degrees from the long axis of the body. It was not a true physiological erection. The glans was not enlarged or engorged. The corpora were distinctly felt as hard cylindrical bodies extending from the suspensory ligament half way to the corona glandis. The left corpus was slightly more prominent than the right and this gave the penis a deflection to the right. There were a few nodosities felt along each corpus which gave the impression that they were thromboses outside the spongy bodies and beneath Buck's fascia. The spongy bodies in the perineum were firm also and could be followed back apparently to their insertion in the ischial rami. From the most anterior point of the firm corpora to the glans, the penis was slightly larger than normal, but was not firm or enlarged as it was posterior to this point. This is well shown in the accompanying photograph of the patient. This gave the impression that there was a semi-erection of the corpora running two-thirds of its length, but that the anterior one-third was not in erection. There were no scars on the penis. The corpus spongiosum was also involved to a point equal to that of the cavernosa. Scrotal contents were entirely normal.

Rectal examination: Showed a normal sphincter and the prostate was essentially normal except for slight increase in firmness. The

seminal vesicles were normal. The firm enlarged corpora were easily felt extending back to their insertion into the ischia.

Neurological examination: Cranial and peripheral nerves were entirely negative. Reflexes equal and active bilaterally.

Clinical data:

Blood count—Differential. White blood cells 12,300. Polymorphonuclears 78 per cent. Lymphocytes 14 per cent. Monocytes and Transitionals 8 per cent. No abnormal cells, red blood cells were normal.

FIG. 1. PHOTOGRAPH OF GENITALIA AT TIME OF ADMISSION

Wassermann reaction—negative.

Phthalein excretion of 45 per cent in two hours. Appearance time ten minutes, 30 per cent first hour. The curve was not a good one as the peak of 15 per cent was reached in one hour and remained at 15 per cent for one and a half hours.

Blood urea—0.400 gram per liter.

Urine showed: Specific gravity 1.006. Albumin trace. Sugar 0. Casts 0. Pus 3 plus. Infection Gram-bacilli.

The impression of the case was that we were dealing with a priapism due to trauma of instrumentation. Because of the long duration of the priapism, it was considered carefully whether or not multiple incisions of the corpora with evacuation of the blood would be successful. It was

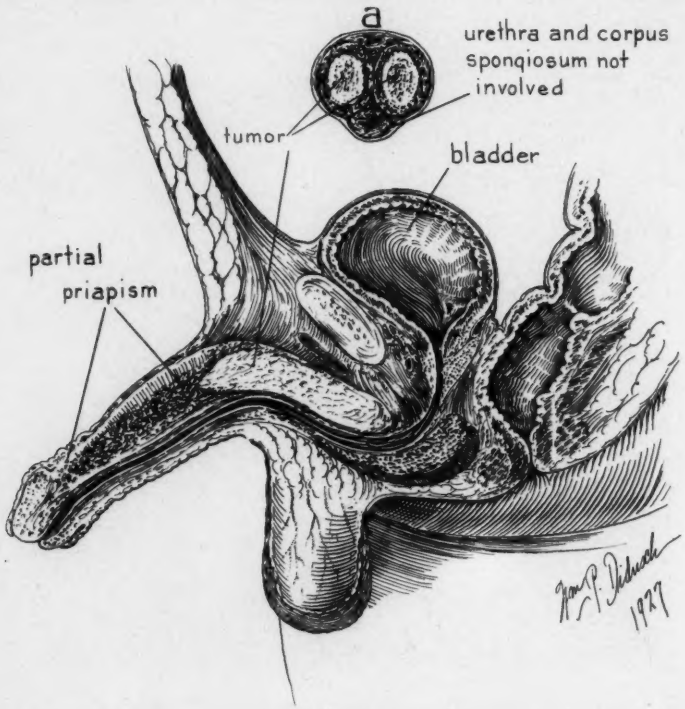

FIG. 2. ILLUSTRATION SHOWING REPLACEMENT OF CORPORA CAVERNOSA BY TUMOR

feared that gangrene might set in, but this operation being the only course open for relief, it was carried out.

March 11, 1927. Under general anesthesia an external urethrotomy (bulbous urethra) was done. The incisions into both corpora extending from the anterior point of the erection to the suspensory ligament were

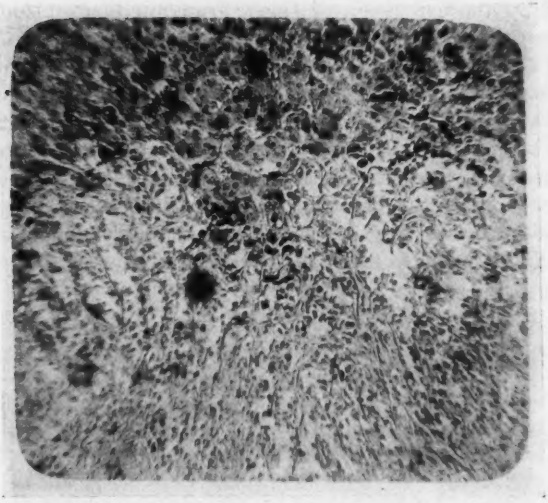

FIG. 3. PHOTOMICROGRAPH OF TISSUE OBTAINED FROM CORPORA CAVERNOSA SHOWING EXTENSIVE TUMOR INVOLVEMENT

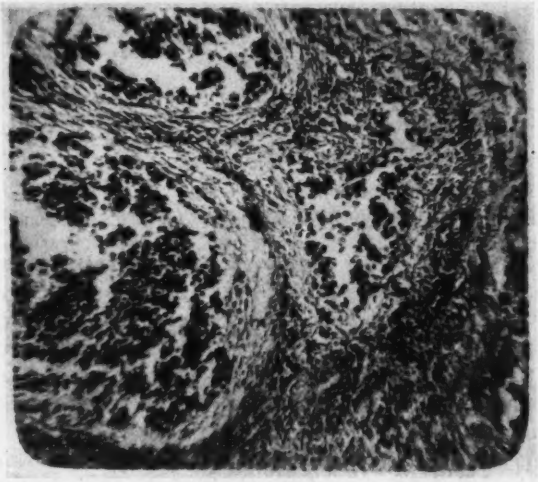

FIG. 4. PHOTOMICROGRAPH SHOWING EXTENSIVE TUMOR INVOLVEMENT OF BLADDER WALL

followed by the expression of thick, grumous, black blood. It was noted now that there was little tendency to bleeding from the spongy tissue of the corpora, but considerable from Buck's fascia, though there was nothing that appeared like gangrene in either corpora. Incisions in Buck's fascia were then carefully approximated by zero catgut and the skin wounds were brought together with silk. A small protective drain was carried down the posterior angle of the wound into each corpus to take care of any subsequent oozing. The penis was put up in mercurochrome dressing. At the close of operation the penis was in a completely flaccid state.

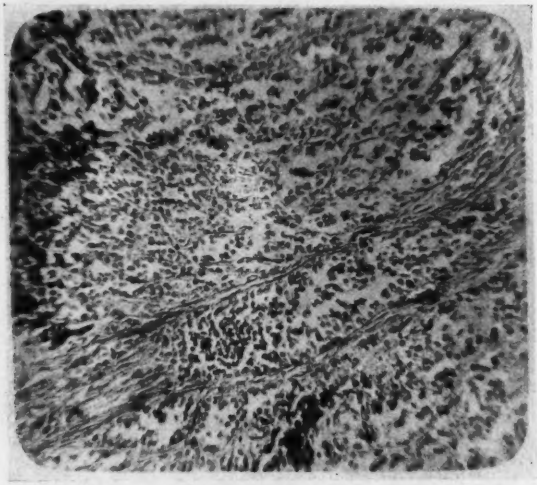

FIG. 5. PHOTOMICROGRAPH SHOWING AREAS OF METASTASIS IN LIVER

His post-operative course was uneventful for ninety-six hours, when it was noticed that the edges of the incision were black and necrotic and the wound very malodorous. It seemed quite evident that there was definite gangrene of the corpora. This was easy to conceive when recalling the little blood supply of the corpora noted at operation. His temperature now had risen to 103° and pulse rate to 140. White blood cells 24,000. Blood culture sterile.

March 17, 1927. A second operation was done at which time it was observed that all the tissues of the shaft of the penis had undergone

autolysis. Amputation of the corpora was done just posterior to the suspensory ligament at which level the blood supply seemed sufficient. A new urethral orifice was also manufactured at this level.

Following this second operation he became progressively worse, temperature mounting to 104 degrees and pulse to 150. Blood remained sterile. The urine was cloudy, but relatively only slightly infected. There was no tenderness over the kidney regions. Blood urea remained at 0.48 gram per liter. In spite of infusion and intravenous glucose he did not rally and developed a terminal pneumonia. He died March 28, 1927. The cause of death other than the terminal pneumonia and general intoxication from the grangrenous process of the penis was not known

A post-mortem examination of the body was obtained.

Post-mortem examination. The autopsy findings were quite remarkable and wholly unsuspected. The urethra just proximal to the point of amputation (anterior bulb) was quite dilated and its mucous membrane covered with a yellowish exudate in which there was considerable hemorrhage. The whole structure of the penis at this level was markedly indurated and this was most pronounced in the corpora cavernosa, each corpus being represented by two solid cylindrical masses of tumor which had replaced completely the spongy tissue. A microscopic section of the corpora and urethra shows an intact urethral mucosa but some of the deeper suburethral glands appear to be involved in the tumor process which in many places assumes an alveolar arrangement. There is much necrosis and old hemorrhage in these areas and in some places tumor cells fill the veins.

While the gross appearance of the prostate suggests only an acute inflammatory process, microscopic section of the gland shows foci of tumor infiltration in both stroma and alveoli. The cells are rather spindle shaped with vesicular nuclei. Extensive metastases were found also around the left seminal vesicle, left spermatic cord and left ureter. The iliac, retroperitoneal, peripancreatic and bronchial lymph nodes were likewise the site of tumor, as were the lungs, liver and right kidney. Section of the liver shows a collection of tumor cells along the course of the portal veins which in places extend up the lumen of the vessel, apparently being attached to the endothelial lining.

RUPTURE OF THE BLADDER IN A CHILD

JOHN R. CAULK

From the Department of Surgery, Washington University, St. Louis, Missouri

I am reporting a case of rupture of the bladder in a child which illustrates several features of interest.

Let it be understood in presenting this case that I am thoroughly aware of the seriousness of rupture of the bladder and of the great importance of prompt surgical intervention at the earliest possible time in the majority of instances. Furthermore, I am cognizant of the proportionate frequency of intra-peritoneal ruptures as compared to those of the extra-peritoneal type, although, I must say that in the few cases which have come under my observation, I have never seen an intra-peritoneal rupture of traumatic origin.

A little girl, six years of age, came into the hospital in the early morning of September 17, 1926, with the following history:

The family had moved to the country the night before her admission and on account of undesirable conditions in the house, they were compelled to sleep in the hay-loft. In the morning the mother and child descended the steps and as the child reached the bottom she fell and at the same time a horse came toward her from his stall and stepped on her lower abdomen. Although considerable pain followed, the child, according to the mother, had never been in shock. The mother said she cried a great deal and complained of soreness and tenderness in the lower part of her abdomen and felt the desire to urinate but could not. She reached the hospital about three hours after the accident, still unable to void. There was no nausea or vomiting. Upon entry into the hospital, her condition was quite good, there was no evidence of shock, the temperature and blood pressure were normal, pulse 88, leukocyte count 24,000. There was moderate lower abdominal distention, considerable tenderness across the hypogastrium. Quite strikingly, there was but the slightest visible indication of an abdominal injury, namely, an ecchymo-

sis about the size of a dime just above the symphysis in the midline. The skin was not broken.

One of the house men who admitted the child catheterized her and recovered 200 cc. of bloody urine, there was no difficulty in inserting the catheter; he then filled bladder with 100 cc. of fluid and withdrew it all.

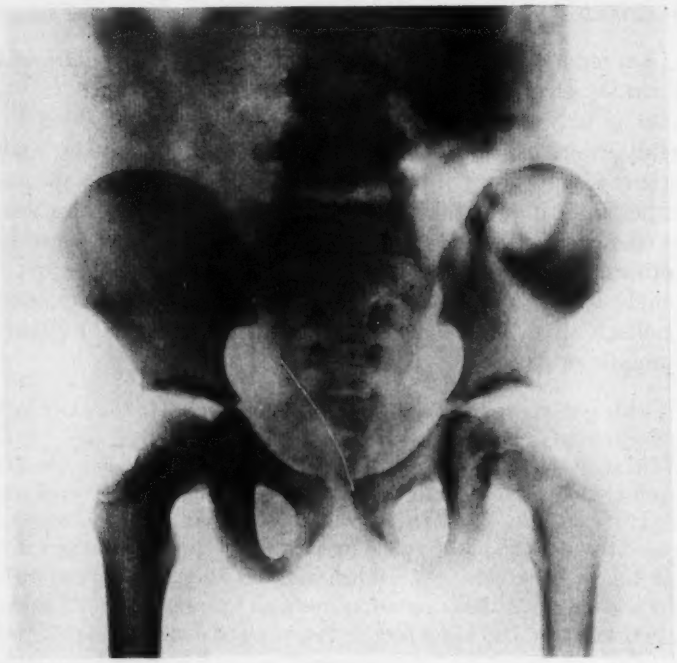

FIG. 1

I saw the child four hours later, that is about seven hours after the accident; her general condition was perfectly good, there was moderate distention of the lower abdomen, no striking dullness in the flanks or in the lower abdominal region, no nausea or vomiting, pulse, however, had increased to 130, leukocyte count dropped to 16,000, her upper abdomen was quite soft. At this time I inserted a catheter and withdrew a small amount of practically clear urine, catheter was retained.

When I first saw the child I felt certain that an immediate operation was necessary, that there was certainly a rupture of the bladder and possibly a fractured pelvis as it seemed quite improbable that a horse could step on this child without causing some bony break. Her x-ray, however, was entirely negative. Her general condition seemed so good and there had been no progressive distention, vomiting, or extension of

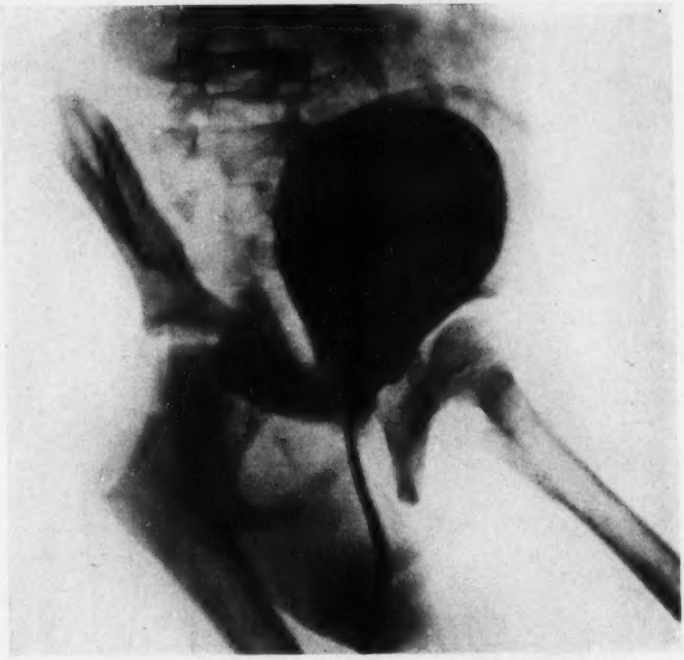

FIG. 2

extravasation, so, in spite of her rapid pulse, I thought it prudent to insert an indwelling catheter and watch her very carefully for a few hours. Toward evening, she was quite comfortable, had not vomited, and still showed no definite indication of peritoneal irritation, leukocytes were still 16,000, pulse 120. It was then decided to watch her until morning.

In the morning I found the child considerably improved, there was

no distention, catheter was draining freely, leukocytes 15,000, she had vomited once after midnight, pulse good, around 100, there was no indication of increased extravasation and for this reason we continued to palliate.

FIG. 3

In the evening of the second day she was in good condition, temperature a little over 100°, catheter draining nicely, no distention, leukocyte count 23,000, no vomiting.

On the third day the abdomen was perfectly soft and flat, there had been no evidence of extravasation, there was still tenderness in the lower

quadrant, no dullness, leukocytes 20,000, urine slightly bloody. From this time on child continued to improve, tenderness in the lower abdomen entirely disappeared.

On the fifth day temperature was normal, general condition excellent.

On the sixth day I cystoscoped her bladder and found a large rent about the size of a nickel on the base of the bladder just lateral to the

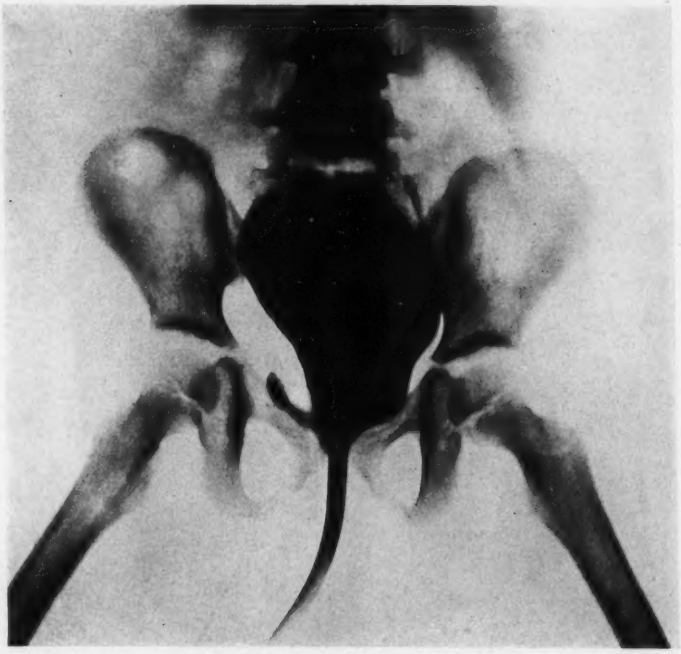

FIG. 4

right margin of the trigone between the ureteral orifice on the right and the internal sphincter, in fact it approximated the internal sphincter. The hole was irregular and ragged and was covered with a great deal of fibrin and slough. The rest of the bladder was perfectly normal. There was no evidence of other openings on any portion of the bladder wall. Urine at this time was cloudy and infected with the colon bacillus, but the child under drainage was free from fever or evidence of absorp-

tion. Ureteral orifice on the right was normal and emitted clear urine. Cystogram done at this time with moderate pressure, showed a very interesting picture as illustrated in figure 2. There is an extra-vesical cavity which resembles a diverticulum connected with the bladder near

FIG. 5

the internal vesical orifice. The cavity is about 2 inches by 1 inch in size and evidently had been larger.

I cystoscoped and cystogrammed this child at weekly intervals and the findings proved very interesting as illustrated in figures 2, 3 and 4.

There was a gradual shrinking of the size of the cavity and with it the opening from the bladder to the outside gradually diminished also. On October 12, five weeks after the injury, the cystogram showed complete disappearance of the extra-vesical infiltration and a normal contour of the bladder. You will note that in figure 4 the bladder wall near the

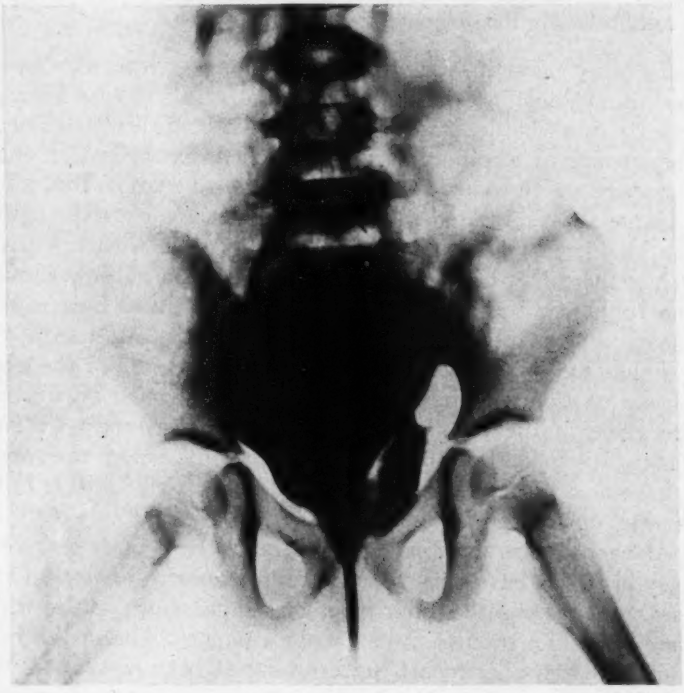

FIG. 6

sphincter is straight, whereas in figure 3 with small extra-vesical punch there is a decided indentation, due unquestionably to muscle spasm.

On the sixth week the bladder opening had entirely healed except for an irregular scar. Catheter passed up the right ureter without obstruction. Retention catheter was then removed and the child was tested for vesical function and was found to carry about 2½ to 3 ounces of residual urine. This gradually disappeared in the course of a couple

of weeks under catheterization, irrigation and instillation. I saw no evidence of contracture and believe that this slight residue resulted from the interference with the sphincter due to the processes in its immediate vicinity. The child since empties her bladder and it is therefore evident that she was not carrying a high residue from a congenital obstruction which was really the predisposing cause of her rupture. It was simply a full bladder in the early morning.

I simply show this case to call attention to nature's defense in certain rare instances of bladder rupture. In this case I am not exactly sure whether it was a clot or peri-vesical fat which blocked the opening or whether it was simply slight extravasation out in the space which walled itself off. It seems incredible that a hole as large as this, located as it was right at the dependant part of the bladder, could be drained thoroughly even with a catheter unless there had been some obstruction to the outflow through the traumatic rent; it, furthermore, demonstrates how rapidly the cavity contracted and disappeared leaving no aftermath.

I shall make no attempt to discuss the literature or the many phases on this very important subject. Thorough descriptions are given in the text books, particularly in Young's Urology. Crosby discussed the subject very thoroughly, before the American Urological Association in 1924, and his article appears in the Journal of Urology of that year.

My experience with bladder rupture has been quite extraordinary in that I have never seen a traumatic intra-peritoneal rupture. I have observed four cases of spontaneous rupture which were cited in a discussion of Crosby's paper. The instances of traumatic extra-peritoneal rupture have all been associated with pelvic fracture or have resulted from tears from spicules of bone either from the symphysis or rami.

Under ordinary circumstances immediate surgery is indicated when a bladder rupture is diagnosed. In the case here reported, the patient's condition was so good and she was under such close observation that I broke the common rule, with no regrets. In intra-peritoneal ruptures, thorough vesical drainage is very essential and I should personally feel that if possible it would be preferable to suture the rent in the bladder wall. The ratio of

the amount of fluid which has been injected into the bladder to that recovered may be deceptive as an index to rupture. Reports indicate that it is not infrequent for extensive intra-peritoneal ruptures to allow the complete recovery of fluids. The air injection test of Vaughn and Rudnick seems to be quite a reliable one.

I have never quite understood the reason for such a tremendous mortality in rupture of the bladder unless associated with injuries involving other organs; it does seem that even our present day mortality of almost 25 per cent is out of bounds. We are told, of course, and it is substantially true, that immediate surgery predicts a lower mortality; the analyses of Ronvillois and Ferron show mortality of 11 per cent if the operation is undertaken in the first twelve hours and 43.7 per cent if done on the second day. An analysis of the cases operated on from the third to the eleventh day, 12 in all, show but one death or 8.3 per cent mortality against an average mortality of the first two days of 29 per cent. This seems paradoxical but is unquestionaly due to the difference in the type of rupture, the ones who are able to endure for three days are the least serious and are almost surely extra-peritoneal, yet this contradicts the statistics of Mitchell who reported 64.9 per cent mortality in extra-peritoneal ruptures, definitely higher than intra-peritoneal at that time.

ABSCESS OF THE TESTICLE

JOHN R. CAULK

From the Department of Surgery, Washington University, St. Louis, Missouri

The attempt to revive your interest in abscess of the testicle is made with a view of impressing you with its comparative frequency, contrary to reports of literature; and of endeavoring, through an analysis of the previously reported cases, as well as the ones which I am presenting, to determine the most likely explanation for its development and finally to suggest that we follow the standard of modern urology in adopting a conservative attitude in its treatment.

As far as I can determine this association has listened to a consideration of this question but once, and that was fourteen years ago when Barney presented a paper dealing with this subject and calling attention to a very rare type of abscess in which no associated inflammatory condition could be determined. He reported 3 cases of his own and stated that up until that time, 1913, there had been no undoubted example of this type of orchitis previously recorded in the Massachusetts General Hospital. In this very excellent paper he concluded that the infection in the testicle was blood borne since there was no demonstrable lesion in the urinary or genital tract. The abscess in the case which he particularly studied was in the lower pole and the epididymis seemed to be free from pathological change.

Having observed several cases of abscess of the testicle during the last year, I began to survey my cases in the hospital and clinic and found, quite to my surprise, that there were fifteen such cases listed. My impression had been that abscess of the testicle was exceedingly rare whether of the so-called idiopathic type as Barney described, or even, if associated with infections of the urinary or genital tract. I had no idea that I had observed such a number and from a perusal of the literature it would seem that

this impression is more or less general. It is chiefly for this reason that I am bringing this subject to your attention.

In the past it was customary to classify all of the inflammations within the tunics as orchitis. Later we find, particularly the French School, classifying such inflammations as epididymo-orchitis. I think, as a rule, the majority of American urologists have considered the two conditions separately and have shown the great preponderance of epididymitis over inflammations of the testicle itself.

Acute inflammatory conditions of the testicle are frequently seen complicating mumps, small pox, typhoid fever and less commonly scarlet, influenza, chicken-pox, etc., but suppurative conditions of these organs are infrequent. It is estimated, for instance, that in typhoid fever 0.2 per cent of the cases have orchitis and about one-fourth of these go on to suppuration. The origin of this condition has been explained by many as resulting from a phlebitis of the spermatic vessels.

In mumps, orchitis occurs much more frequently. At least one case in every four or five having mumps, has this condition as a complication, but suppurative processes are rare. This same holds true for small-pox. It may be that the difference in suppurative changes in mumps and typhoid is due to the frequency of infections of the urinary tract in typhoid fever. Hence typhoid may be explained either by direct transmission along the seminal tract or through the lymphatics as well as by the vascular system.

In younger individuals, and occasionally in older subjects, torsion of the spermatic cord with its resultant necrosis and the production of secondary suppurative changes, is an important cause for abscess.

Scudder collected 32 such cases (Annals of Surgery, 1901). Ombrédanne (Presse Med., 1913) stated that in young boys, torsion of the cord was the important cause of abscess. Barney believes that the majority of abscesses of the testicle result from infection brought through the circulation. Other writers stress particularly the seminal ducts, vas, and epididymes, and still others associate an important place to the lymphatics. Dalous (French Annals, 1905, Ann. des. mal. des. org. Genito-Urinaires)

gives a very careful analysis from a histological standpoint and concludes that the process in a great measure extends along the natural channels, but that the lymphatics play an important rôle. Nash (British Med., 1918) reports 2 cases of abscess of the testicle due to the colon bacillus. Both were associated with pus in the urine and epididymitis. He assumes the infection travels by way of the vas. In 1894, in the London Lancet, Morris reports a case of a young man twenty-one in whom there was associated deep urethral irritation, tenderness along the vas, but he states that the inflammation was confined to the testicle; incision and drainage was the procedure. Bonner cites a case of suppuration of the testicle following heavy muscular effort; his patient also had evidence of chronic infection of the genito-urinary tract.

Therefore, regardless of cause, the reports of abscess of the testicle in the literature are exceedingly sparse.

The testicle is protected very difinitely from invasion by its rich blood and lymphatic supply as well as by means of the tunic albuginea so that complicating inflammatory reactions in the testicle from the epididymis are fortunately not common. Barney believes that possibly the internal secretion of the testicle may contribute to its comparative immunity to infection.

Indeed I have felt, and I imagine many of you have also, that acute epididymitis was very rarely complicated by orchitis and yet as I look over our records I find that out of 270 cases of epididymitis there have occurred 13 cases of abscess of the testicle, or about 5 per cent which is decidedly higher than my impression had been.

This percentage may not be accurate since it is possible that a number of cases of epididymitis are not indexed on the records; at any rate it approximates the real and at that it is surprisingly higher than I expected.

Permit me now to submit to you an analysis of the 15 cases which have come under my observation. There seems to be no necessity for a detailed description of each individual case and only the essentials will be dispensed.

The average age was fifty-four, 10 were over fifty; there was but 1 young individual, age twenty-three, in the series. There

were 14 whites and 1 colored patient. This condition occurred 8 times on the right side, 5 times on the left, and twice bilateral.

The associated conditions and predisposing causes were:

Epididymitis	13
Pyelonephritis	8
Prostatic obstructions, cystitis, prostatitis and seminal vesiculitis	13

Ten patients developed the condition along with prostatic obstruction either benign or malignant, gross or small and in each instance the patients were on catheter drainage or were being subjected to instrumentation of one type or another. One patient developed abscess during the course of a calculus pyelonephritis of colon bacillus origin, the abscess not occurring as a result of instrumentation but spontaneously.

Abscesses occurred in 2 other patients, out of a clear sky, both had been previously treated for chronic prostatitis and seminal vesiculitis, both had clear urine at the time of the development of the abscess and gave no evidences of urinary distress. One of these patients showed cloudy urine on the day following the scrotal involvement, they both had considerable pus in their prostatic and seminal vesicle secretion and I feel resulted from the infection in these structures. We know how frequent it is to find clear urine in prostatic and seminal vesicle inflammations which give rise to acute or subacute epididymitis. We are, furthermore, familiar with the change of the seminal contents following massage. It is far from extraordinary to find very little pus in the first expression and quite a definite amount in the next emptying; so that one examination of the prostatic fluid is not always significant. Hence a single analysis would not preclude the possibility of the internal genital tract as the source of infection.

These two patients appear somewhat similar to the one described by Barney. Neither of these presented urinary symptom at the time of admission but both had suffered such symptoms previously. Barney's patient had severe dysuria and tenesmus two months before the development of the abscess. In his patient, as well as in these two of mine, the urine was clear and

sparkling on admission. In my two the prostatic and vesicle secretion, as was previously stated, showed infection; in Barney's, however, the analysis was negative but patient promptly developed a urethral discharge and pyuria a short time following removal of the testis. I should certainly feel that there was some likelihood of an insidious infection in the prostate and vesicles at the time of the abscess since it was evidently there both before and after and I am inclined to believe that the internal structures were the causative factors in the infection rather than the late result of excretion of infection from the testicle by way of the natural channels.

Our proof of testicle excretion is far from definite. Jäckh finding tubercle bacilli in the tubules of apparently normal testes in case of generalized tuberculosis is not sufficient proof of this phenomenon.

Esmonet, (thesis of Paris, 1902) showed that the testicle could be much more readily infected by injection of the tubercle bacillus into the general circulation than through the vas deferens, and the work of Walker confirmed this.

No one can doubt that the testicle, like the kidney or any other important organ, particularly with such a rich blood supply, can receive microörganisms through the blood stream and become infected by them.

The analysis of the cases which I have presented simply shows that the path of infection seems to have been either along the natural channels, the vas and epididymis, or by way of the lymphatics. Since, in the 15 cases studied, uro-genital infections were present in 13, the other 2 resulted from surgical injury with consequent circulatory interference. In the 3 cases of orchidectomy which have been performed in this series 2 showed definite changes in the epididymis, the other marked perivascular involvement at the site of the lymphatics and clinically epididymitis was proved in 13 of the 15 cases.

The location of the abscess in the testicle in the cases analyzed was in the upper pole seven times, in the upper and lower poles once, that is two distinct abscesses, complete destruction of testicle at first observation twice, and in five instances no definite note was made.

The clinical history of these patients has been somewhat similar, they have started with epididymitis, usually not severe, more of a sub-acute type, with only moderate fever, from 100.5° to 102°, but instead of retrogressing, the process seemed to remain stationary for variable periods and suddenly to become ignited without any apparent predisposing cause; a few have suddenly developed chills and fever, in two instances 106°. The patient is at first quite severely ill. The scrotum becomes rapidly swollen and changes its configuration; instead of being projected below and tender in this neighborhood it has a tendency to protrude at its upper part, usually presenting one promontory, which becomes shiny and glassy. The leukocyte count ranges from 20,000 to 30,000 in the acute stage. This process can be explained on the basis of obstruction near the vas or epididymis with stasis and back pressure through the rete testis to the testicle of a nature similar to that observed in the upper urinary tract subject to ureteral obstruction.

Some of the early cases which were not properly drained showed in the course of a few days recession of temperature, tenderness and enlargement, but in all instances, of course, either drainage or removal was necessary.

In two instances patients entered with a discharging sinus from the testicle, one of which had ruptured spontaneously several months previously and the other had been incised. The one which had opened spontaneously was associated with an irregular epididymitis which I was inclined to believe tuberculosis but examination of the specimen after removal proved it to be of pyogenic origin.

This condition complicated two cases of vesical calculi and two instances of neurogenic bladder. Two resulted from hydrocele operations, one of which was done by one of my house men, the other by a surgeon in another city. These abscesses developed promptly following the operation and evidently resulted from circulatory interference with gangrene of the testicle and secondary infection. The one observed in our clinic was removed thirteen days after the hydrocele operation which was complicated in the first place by a hematoma of the scrotum due

to improper hemastasis. Evidently, at the second operation, done in forty-eight hours after the original one to stop the bleeding, the circulation of the testicle was interfered with by a stitch at the upper part in the funicular process; since, I find in the operative note that this was done. On the thirteenth day the testicle was enormously enlarged, blue black in color, and very fluctuant; upon removal it was found to be completely necrotic, its contents were exceedingly foul, culture sterile.

The other case of similar nature came to me several months after the hydrocele had been done in another city and a large sequestrum of testicle was removed back of which was a definite amount of foul smelling pent-up pus. This patient had had his other testicle removed a number of years ago for what he said was tuberculosis. His history, however, does not seem to indicate it. At any rate it was felt that in spite of this intense necrosis at the time that it was essential to attempt the preservation of even the smallest amount of testicular tissue; for this reason orchidectomy was not performed, but thorough cleansing and attention to the drainage was followed within two weeks by complete healing and there is at present, six months later, a small pea-sized lump in the left scrotum which is evidently sufficient to maintain his male characteristics and his sexual capacities. It illustrates how little is necessary and bespeaks for a most conservative therapy in suppurative conditions of these organs.

The organism present was usually the colon or the staphylococci. In several instances cultures were negative and in a number there was no culture made as they were drained in the office or in their homes. Two of the patients had had previous epididymotomy for acute epididymitis.

Twelve patients were treated by drainage and healed, necrotic plugs or sequestrae required removal along with drainage. Free drainage, care in cleansing the wound, removal of necrotic material gently so as not to invade healthy parts, is paramount. In each of my cases, the sinus has healed in from two to six weeks and while in many instances there has been but little normal testicle tissue conserved, I feel that it is very appropriate and indeed oft-times extremely essential to conserve as much of the

vital organ as possible, and in such a condition there is seldom anything to lose and so much to gain by conservative therapy.

It is obvious, therefore, that abscess of the testicle is far from a rarity, that its origin in the majority of instances seems to be from some focus in the uro-genital tract, and that in the majority of instances it is transported by way of the natural channels or the lymphatics, and that the tendency of the lesion is toward destruction of the testicle but with early drainage and great care and attention to the wound the conservation of a certain amount of normal secreting cells is possible and highly desirable.

DISCUSSION

Dr. GEORGE GILBERT SMITH (Boston): I would like to say a word about the treatment of these cases of abscess of the testicle from the point of view of a case which I saw. I agree entirely with Dr. Caulk that conservative treatment is the proper course to follow, and I feel it all the more strongly in the light of this particular case.

This was the case of a man in the early thirties who had had no past venereal history. He had been on a vacation, had overeaten and become constipated. When I saw him first, he was suffering from an acute prostatitis. He rapidly developed what I thought was a left epididymitis. The epididymitis turned out to be an orchitis with an abscess presenting. This was incised and drained for about two weeks, when the patient was discharged. About a month after he went home, he developed the same condition in the other side and went through exactly the same course. He developed an abscess of the right testicle, which was also incised and drained, and that healed up. His urinary and prostatic infection then cleared up.

As a result of both these infections, he had a small nodule, about the size of a large pea, in the region where each testicle should be, with slight testicular sensation on pressure, and, as Dr. Caulk has said about his cases, there appeared to be no disturbance of internal testicular secretions, so far as could be ascertained six or eight months after this infection had occurred.

I think this case illustrates the value of leaving in situ the testicular tissue which will live, rather than doing an orchidectomy early in the game.

Dr. ROGER C. GRAVES (Boston): I have just reported elsewhere a case that parallels with Dr. Frontz' interesting case, at least to the extent of being an instance of priapism of rare origin. The patient was a healthy, hard-working Irish laborer of forty-

six. He was a man of exemplary habits and the father of a healthy family. His past health had been uniformly good, and he had never had any disturbance of his genito-urinary system.

When I first saw him, he gave a story of a sudden onset of priapism one week before. There had been no previous sexual or alcoholic indulgence. Two weeks before the onset of this trouble, he had had a severe cold, and for two or three days during paroxysms of coughing, he complained of a slight indefinite discomfort in the perineum. This was very transient and had disappeared several days before the beginning of the persistent erection of the penis.

Examination found the patient in extreme discomfort because of the priapism which was marked in degree in spite of the efforts of the family doctor to relieve it by the usual cold applications and narcotics. The lesion involved both corpora cavernosa. The corpus spongiosum was not affected. Physical examination was otherwise absolutely negative. The urine was normal, as was the blood. Careful exploration of the urethra and the deep genital tract under ether failed to explain the condition and the anesthetic did not alter the state of priapism. A neurological consultation was held with negative results.

Three weeks from the onset of the erection, I operated upon the man, having exhausted every other possible means of relief, without avail. The patient was placed in a lithotomy position and the corpus was exposed on each side as it comes away from the ramus of the ischium. Longitudinal incisions into the cavernous bodies then met with the escape of the same sort of tarry viscid substance that Dr. Frontz encountered. I next made two other linear incisions on each side, along the shaft of the penis with the same results. The corpora had apparently been converted into mere cylinders filled with what appeared to be old blood and destroyed erectile tissue. Cultures of this material were negative. The wounds were packed with iodoform gauze and at the close of the operation the priapism had disappeared. I did not find it necessary to do an external urethrotomy.

The lesion in this case was apparently a thrombosis in the

blood spaces of the erectile tissue of the corpora cavernosa. The absence of any direct or contributing cause, however, is unusual. In spite of the negative cultures there may have been present in the beginnng some low-grade infection, which, judging from the story, may have had its origin in the respiratory tract.

I saw the patient several months after operation. The penis appeared normal except for the scars, and functional recovery was reported to be complete.

Dr. NATHANIEL P. RATHBUN (Brooklyn): A case of abscess of the testicle developed in a young man with respiratory infection. He was operated upon. There was no evidence of any involvement in his urinary tract or prostate or seminal vesicles. At operation the pus was sterile; there was no evidence of any involvement of the epididymis. The patient was in perfectly good condition after the operation and for three or four or five days after. He then developed a serious condition with a staphylococcus aureus in his blood stream. He has received various palliative measures, but I think the case is going to end fatally.

Dr. NATHANIEL G. ALCOCK (Iowa City): I have a case that is a double of Dr. Frontz's, that we saw some years ago. This man had a stricture of gonorrheal origin. He had it for about fifteen years. His priapism came on after instrumentation, but came on slowly over a period of some three or four days. I saw him some two months after this started and it had been constant since that time. It involved both corporas and was extremely painful. I amputated the penis as a palliative measure. When it was amputated, the corpora remained firm, but in doing the amputation I found a sterile abscess with bloody pus in it at the base of the penis, outside of the sheath.

This case has never been reported because the pathologists have disagreed on the histology. The diagnosis of one group of pathologists was sarcoma; of another endothelioma, and two or three held that it was carcinoma. Those who said "carcinoma" put the origin of the carcinoma in the urethra. The

stricture that he had was in the anterior urethra, and that was found and was not carcinoma. A section of the urethra which was removed showed no changes. He developed no metastases excepting that of direct extension involving the descending rami of the pubes, and died some year and a half afterwards.

Dr. J. Dellinger Barney (Boston): My name having been used so freely this morning by Dr. Caulk, I feel that I ought to say something in regard to abscess of the testicle. At the time of my report, I think fourteen years ago, I tried to get information from various of my colleagues, and they thought my observations probably were faulty. They said they had never seen a case of abscess of the testicle, in and of itself, without coexistence of an epididymitis. However, since that time a good many cases have been seen.

I have seen a good many cases of epididymitis of course, and I have seen also a certain number of those which have involved the testicle, but which I considered to be secondary to the abscess of the testicle. Just what the etiology or the method of transmission of bacteria is, I do not know, but I still think that it is probably a blood stream affair. I think that it is remarkable, however, that the testicle can resist the onslaughts of so many different kinds of virulent organisms. They seem to prefer the epididymis. The tubercle bacillus rarely touches it except as a secondary affair, and whatever the organism is in scarlet fever, it does not seem to hit the testicle. It has a peculiar resistance of its own, which I think is of interest.

Dr. C. E. Burford (St. Louis): In the late epidemic of mumps at Camp Dodge, we found a few cases where orchitis developed before the regular mumps symptoms, and in one of these, not knowing the cause of the orchitis, the testicle swelling very acutely, we incised it early and got drainage of serum only. It probably would not have become an abscess; but we were interested to find that the swelling subsided rapidly and there was not an atrophy of the testicle; that is, to any appreciable extent, whereas we had had a large number of very disastrous cases of

complete atrophy in well-developed men in the camp previously. This led us to experiment on one other case.

The epidemic had about subsided when we had opportunity to incise one other case during the acute swelling of the testicle. No epididymitis was present in either case, and there was no appreciable atrophy in either. I have not heard this discussed and thought that as a preventive measure, against atrophy an early incision in the orchitis of mumps might be worth while.

Dr. J. A. C. COLSTON (Baltimore): I have seen two cases of priapism which are interesting, the first one chiefly on account of etiology, and the second one on account of the more or less conservative methods of treatment that has given rather excellent results so far, although the case is still under observation.

The first one was a case of a locomotive engineer who was undergoing chiropractic adjustment and in the course of this adjustment, severe trauma was done to the lumbar spine, which was followed a few days later by a very severe priapism. This persisted over a course of about two or three weeks, but as long as the circulation seemed to be intact, nothing but local measures were carried out and the priapism slowly disappeared.

The second case was a case of priapism of entirely unknown etiology, although the patient had had a cardio-respiratory infection about a month previously. His neurological tests were entirely negative; blood Wassermann entirely negative. On account of the fact that the blood circulation was intact, we decided before carrying out any operative procedure, to see if the corpora could be relieved of the tenseness by simple aspiration, and this was done, about three punctures being made in each corpora with a rather large-bore needle, and black blood was drawn out, and then the corpora could be very well irrigated with salt solution. This was done on three occasions; the priapism was remarkably relieved and is very much improved, although it has not entirely disappeared as yet, the case being still under observation. I think that this procedure should be considered before any operative procedures are undertaken, of course, remembering that the circulation must be intact before such procedures should be carried out.

Dr. EDWARD L. KEYES (New York City): If I may also deviate a little in the direction of mumps, one of the internes at the Willard Parker Hospital, in New York, which is an infectious disease hospital, has developed the theory that the so-called metastatic complication of mumps is due to contact infection, and as they happen to have had a great many cases of mumps this winter and he has been in touch not only with the sick but also with the contacts, he has warned all contacts that there was a possibility of contact infection and they must wash their hands before touching their genitals. He believes that by so doing he has very markedly reduced the incidence of the complication in these contacts. The report is not yet published.

In the second place, it seems to me one should mention in this discussion the existence in the Orient of the two types of eunuchs; the one totally emasculated before reaching puberty and who are drudge-slaves; the others who are only castrated after reaching puberty and maintain their sexual functions for a definite period. I am not at all in sympathy with the suggestion of Dr. Caulk that there is any physiological or physical value to the small, pea-sized nodules left by his operation. I should say that this method of removing the testicle entirely makes a much cleaner and quicker job. We have always felt that any wound that showed the strings of tubules and was not promptly treated by orchidectomy would result in a very long, tedious and annoying healing.

Dr. WILLIAM A. FRONTZ (Baltimore) (closing): I have been able to find in our records, 12 cases diagnosed as priapism, but in only 4 of these cases, however, was the condition a true priapism; two of them were associated with spinal lues and apparently this was the etiological factor. Both these cases responded quite promptly to arsphenamin therapy. The other 2 cases were of undetermined etiology. Both of these were treated by incision of the corpora. In one of them there was no recurrence of the priapism, but in the other the priapism promptly recurred, persisted for a period of three weeks and then spontaneously cleared up.

I think that the method mentioned by Dr. Colston, that of aspiration, should always be employed first, because it saves a considerable operation and there is no certainty from an operation that a permanent result will be secured.

Dr. JOHN R. CAULK (St. Louis) (closing): I simply have to say that if we were subjecting our patients to any particular hazard by not removing the testicle, it would be a different story, but I really believe we should preserve all the vital tissues possible, and I do not know that we are informed thoroughly as to whether or not a little piece of tissue might not regenerate and support the internal secretion for the individual. I, personally, would not consider removing the testicle, and believe that we should preserve as much of the testicular tissue as possible, since we run no chance in so doing.